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RESEARCHES ON THE MOTION OF THE MOON AND RELATED ASTRONOMICAL ELEMENTS BASED ON OBSERVATIONS EXTENDING FROM THE ERA OF THE BABYLONIANS UNTIL A. D. 1908

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RESEARCHES ON THE MOTION OF THE MOON

By SIMON NEWCOMB.

PART II.

THE MEAN MOTION OF THE MOON AND OTHER ASTRONOMICAL ELEMENTS DERIVED FROM OBSERVATIONS OF ECLIPSES AND OCCULTATIONS EXTENDING FROM THE PERIOD OF THE BABYLONIANS UNTIL A. D. 1908.

UNITED STATES OF AMERICA
GOVERNMENT PRINTING OFFICE

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PREFATORY NOTE.

The present work is the last of a series of papers on the Moon by Professor Newcomb, extending over a period of 40 years. It was completed during his last illness and the copy for the printer was finished only a month before his death. In putting this work through the press Dr. F. E. Ross, who was associated with Professor Newcomb throughout its entire preparation, has been freely consulted with the view of overcoming as far as possible the disadvantage in publishing such a work without the assistance of the author. It would doubtless have been changed in many minor points at least if it had been possible for him to have seen the proof.

The arduous work of proof reading has been performed by Mr. H. G. Hodgkins and Mr. Arthur Snow of this office.

W. S. Eichelberger,
Professor of Mathematics, U. S. Navy,
Director Nautical Almanac.

Nautical Almanac Office, *May, 1912.*

PREFACE.

More than 30 years have elapsed since the publication of the author's Researches on the Motion of the Moon as an appendix to the Washington Observations for 1875. These researches were incomplete in being devoted almost entirely to observations before 1750. In the present work, which is a continuation of the former one, the discussion is brought down to the present time. As thus completed, the whole work may be described as a discussion of ancient and mediæval eclipses of the sun and moon, and of occultations of stars by the moon observed from 1627 to the present time, with the general purpose of studying those fluctuations in the moon's motion which are not represented by existing theory. The work also includes a determination of some of the fundamental astronomical elements from the occultations, which may prove more accurate than any afforded by the older methods.

The most important fact brought out by this and other researches of the author on this subject, and by a comparison with the theoretical researches of other investigators, especially of Prof. Ernest W. Brown, is that the moon's mean motion is subject to fluctuations which are not only unrepresented by existing theory, but for which it seems difficult to assign any sufficient physical cause. That fluctuations exist has been known from the time of Laplace, but the question whether they could be represented by gravitational theory was long a mooted one. Hansen supposed that the inequalities were completely explained by his discovery of two terms of long period, due to the action of Venus on the moon. His tables of the moon, which were published in 1857, embodied these inequalities, and were supposed to represent both ancient and modern observations in a satisfactory way.

The evidence adduced by Hansen for the supposed agreement was limited to the period 1750 to 1855. During this period observations were so well represented by the tables that Hansen's view seemed well established. But from 1862 to 1869 the tables deviated from observation in such an unexpected way that the author undertook a comparison of their results with observations before 1750. The only available observations which seemed worth using were occultations of stars by the moon, and solar eclipses. He found that the deviation from observation was unexpectedly wide, showing large fluctuations in the moon's mean motion not represented by Hansen's tables. As the most recent observations showed that the moon was falling behind its tabular place at a rate of more than half a second annually, the author entered upon two lines of investigation: one, to find whether any unknown inequalities of long period could be derived from theory; the other, what inequalities were shown to exist by the totality of available observations. To prosecute this last inquiry it became necessary to work up all the earlier available observations, and to ascertain what light would be thrown on the subject by ancient records of solar and lunar eclipses. For this purpose a search was made into the manuscript records of several European observatories, especially that of Paris, with a view of finding unpublished observations of occultations. It was found that such observations had been made from 1672 until about 1740 of such precision that by careful discussion it was possible to trace out the mean motion of the moon in longitude with a precision fairly comparable with that reached by meridian observations during the first half of the nineteenth century.

The determination of the secular acceleration being a necessary part of the work, a discussion of ancient solar eclipses was also undertaken. Great stress having been laid on real or supposed records of such eclipses found in the works of ancient historians, the question arose as to their availability for the purpose in question. As this subject is rediscussed in the present work, it will suffice to remark here that the records in question failed to inspire the author with any confidence that reliable conclusions could be derived from them. It appeared that the only ancient data that could be safely used for the determination of the secular acceleration were the eclipses of the moon recorded by Ptolemy in the Almagest, and a number of solar and lunar eclipses observed by Arabian astronomers during the ninth and tenth centuries.

Combining these with the most recent observations, it was found that the apparent secular acceleration was little more than half that which had generally been adopted, and little greater than that derived from modern theory. This result implied a smaller tidal retardation of the earth's rotation than had been supposed probable. The subject thus opened up has been widely discussed from various points of view by contemporary astronomers. Their conclusions are, so far as it seems necessary to the purpose of the present work, reviewed and discussed in the following chapters.

One conclusion of the former work was that at least one fluctuation having a period of nearly three centuries, and a coefficient exceeding 10″, still existed in the moon's mean motion, which was not explained by theory. The author's efforts to find a term in the theory which would represent this fluctuation have appeared in two memoirs. The first was published in 1896 as Volume V, Part III, of Astronomical Papers of the American Ephemeris; the other was published by the Carnegie Institution as No. 72 of its publications. Of these works it is only necessary to say that no such term has been found, and that it is difficult to see any possibility that it can exist in gravitational theory. Yet more complete and exhaustive is the recent work of Brown, which seems to establish the nonexistence of such a term.

The first step in the explanation of an anomalous phenomenon is a precise knowledge of its character. The main purpose of the present work is, therefore, to show with all the precision of which the observations admit, what unexplained fluctuations the mean motion of the moon has actually undergone.

The mass of material on which the work is based is so large, and the computations have proved so prolix and varied, that a full presentation of the processes would be difficult for any student of the subject to follow. It has therefore been deemed best to limit the published work to those steps and results which will best facilitate its criticism, revision, and use by the future investigator. It can scarcely be supposed that anyone, even should he reconstruct the entire work, would repeat the author's study of each individual observation. A systematic and complete list of the original sources is therefore not given, and the published steps of computation have been reduced to those best adapted to test their correctness and facilitate such revision as may be found necessary. An attempt has been made to so plan and arrange the chapters that the student of the work shall find it as easy as possible to trace out and revise any of its processes for himself in his own way. The analytic table of contents has been arranged with this end in view. To avoid the necessity of going over this table in each special case, it may be remarked that matters relating to the purpose of the work and the reasons for the form which it has assumed will generally be found in the introductory chapter under the appropriate head for each. The subsequent chapters are so planned and arranged that each shall be, so far as is possible, complete in itself. Detailed contents of each will be found at its beginning whenever the work of examination would thus be facilitated. The author emphasizes this policy owing to the difficulty he often finds in looking up special points in the works of his fellow investigators, not to say his own. It is too often necessary to go over a large portion of a work to find some special point, such as the meaning of a symbol, the character of a result, or the nature of a process.

It is expected that the computations will all be arranged, collected, and preserved at the Naval Observatory in the archives of the Nautical Almanac Office in such form that the student of the subject who wishes to see the original computations can readily find those pertaining to any of the chapters. For the most part the papers are divided into six classes, which were originally kept in as many cases designed for the purpose. These classes are:

(A) Matters pertaining to the reduction of the observations so as to obtain the local and Greenwich mean time of each. This class is largely composed of copies of observations either supplied by the observers or obtained from printed data; of the time reductions for the older observations; matters pertaining to the geographical positions of the stations; and miscellaneous information generally as to the work.

(B) The computations and copies of tabular geocentric positions of the moon. Most of these tabular positions were computed in bound books on ruled and printed forms, but many were made on forms prepared by the computer.

(C) Matters pertaining to the positions of the occulted stars; especially their longitudes and latitudes.

(D) Reductions for parallax and computations of the differential coefficients, both of which are made on the same forms.

(E) Tabular summary of the reductions of class A.

(F) Final revision of the coefficients, solution of the equations of condition, and discussion of the results generally.

As a general rule, computations pertaining to the corrections have been placed in the same class with those of the quantities corrected. There is a large and quite miscellaneous mass of computations for correcting the parallaxes, observed time, etc. In the final computations the various parallactic and miscellaneous corrections were computed together and the results combined.

As the author has already intimated, he can not conceive that it will be worth while for anyone to attempt the revision or even the examination of this great mass of computations in detail. In the reconstruction of the work most of the numbers, especially those pertaining to the equations of condition, can be used without revision. The corrections to the tabular longitudes, and parallactic corrections, if the work is revised, should be recomputed *ab initio.*

The great number of computers employed on the work from time to time and the period of 30 years through which it extended, during which supposedly improved values of the astronomical elements became available, have resulted in a great portion of the correctional work being done several times over with continually improved numbers. The author does not disguise the inevitable advantage which the future investigator of the subject will enjoy in being able to start with definitive provisional data and carry it through every branch of the work on a uniform system.

As to the history of the work itself, it may be remarked that at the time of publishing the former researches the author had in view the speedy continuance of the discussion from 1750 till the present time. The great mass of the occultations observed during this period were worked up under his direction in the office of the Nautical Almanac during the years 1878–1888. Owing to the necessity of completing the planetary tables, the work had then to be laid aside. The official retirement of the author from active service in 1897 threw difficulties in the way of its continuance as an official work. In 1903, through the agency of the Carnegie Institution, an arrangement was made with the Navy Department for its continuance under the auspices of that institution, to which the unfinished work was turned over from the archives of the Nautical Almanac Office and of the Naval Observatory.

During the 15 years which had elapsed since the cessation of the work, much better determinations of the fundamental elements of reduction had become available, and it was found that important corrections were sometimes necessary in consequence. The introduction of these corrections was no easy matter, and was made more laborious from the fact that, even in the

original work, some of the elements had been changed as supposedly improved values became available. Most important among these are the constants pertaining to the ellipticity of the earth and the parallax of the moon. Of the difficulties incident to the frequent changes of computers, to the preparation of formulæ for their use, and to the avoidance of accidental and systematic errors of computation, it is unnecessary to speak. It will suffice to remark that the details of the work have been so arranged as to make the discovery of any errors thus arising and still uncorrected as easy as possible.

Acknowledgment is due the Carnegie Institution for the very liberal way in which it has made the grants necessary for the employment of computers, and for clerical assistance in the work. On the official side it is worthy of record that the great mass of the earlier computations was made by young officers of the Navy, whose training well fitted them for such work.

In the completion of the work the author takes pleasure in acknowledging the very important services rendered by Dr. Frank E. Ross, who has acted both as computer and superintendent of computations, and whose care and efficiency in the performance of these duties have contributed greatly to facilitate the completion of the work and insure its correctness. As the author is unable to revise the proof himself, the task of seeing the work through the press must devolve upon others, probably on Dr. Ross.

The author's thanks are also due to Prof. E. W. Brown, who has made a thorough and critical examination of the entire work before it was passed for the press, resulting in a number of minor emendations.

WASHINGTON, JUNE 15, 1909.

Analysis of the Contents.

Bibliography.

The following is a list, perhaps incomplete, of the author's writings on the lunar theory, especially the development of the enigmatical fluctuations in the moon's mean motion. He would have been glad to make a complete bibliography by all the writers on the subject, but he believes that scarcely anyone besides himself has written at length on this particular branch of the lunar theory. Such bibliography should include the investigations of Airy, especially his reductions and discussions of the Greenwich lunar observations from 1753 until 1850. The original material for this work is found in the publications of the Royal Observatory. Several of Airy's papers discussing the results are found in the Philosophical Transactions and in the Memoirs and the Monthly Notices of the Royal Astronomical Society.

The author first called attention to the inconsistencies between theory and observation about the year 1869. Since then his papers on the subject have been the following:

1. Considerations on the apparent inequalities of long period in the mean motion of the moon. American Journal of Science, Series II, Vol. L, pp. 183–194, September, 1870. (Read before the National Academy, April, 1870.)
2. On a hitherto unnoticed apparent inequality in the longitude of the moon. Monthly Notices, R. A. S., Vol. XXXVI, pp. 358–361, June, 1876.
3. Papers published by the Commission on the Transit of Venus. (This is the first of the author's series of researches on the elements of the moon's motion. That it appears in connection with the transit of Venus arises from its being undertaken in order to correct the tabular longitude of the moon for all known sources of error in order to determine the longitudes of the stations occupied for the observations of the transit.)
4. Note on the new inequalities in the moon's longitude, pointed out by Mr. Neison. Monthly Notices, R. A. S., Vol. XXXVII, pp. 428–430, June, 1877.
5. On the mean motion of the moon. American Journal of Science, Series III, Vol. XIV, pp. 401–410, November, 1877. (This is an abstract of the next paper.) Also a summary in the English Mechanic, Vol. XXVI, p. 400, January, 1878.
6. Researches on the motion of the moon made at the United States Naval Observatory, Washington. Part I: Reduction and discussion of observations of the moon before 1750. Washington, 1878. (Appendix 2, Washington Observations, 1875.)
7. Note on the correction to the mean longitude of Hansen's lunar tables. Monthly Notices, R. A. S., Vol. XL, pp. 81–82, December, 1879.
8. A transformation of Hansen's lunar theory compared with the theory of Delaunay, by Simon Newcomb, aided by John Meier. Astronomical Papers, Vol. I, Part II., pp. 57–107, 1882.
9. The apparent inequality in the mean motion of the moon. Letter dated Neuchatel, Switzerland, July 11, 1883. The Observatory, London, Vol. VI, pp. 243–244, August, 1883.
10. Remarks on published corrections to Hansen's Lunar Tables. Astronomische Nachrichten, Bd. 107, s. 269–270, December 4, 1883.

11. Theory of the inequalities in the motion of the moon produced by the action of the planets. Astronomical Papers, Vol. V, Part III, pp. 97–295, 1894. (The work developed in this paper was actually carried through more than 20 years before its publication, which was delayed in the hope that the author would be able to put the method into a satisfactory practical form. It has since been proved that as a general method it can not be made practical. But many of its formulæ and developments seem to be of use in the lunar theory; at least such is the opinion professed by Prof. E. W. Brown.)
12. On the use of statements of ancient solar eclipses for correcting the elements of the moon's motion, with special reference to Professor Ginzel's "Specieller Kanon der Finsternisse." Astronomische Nachrichten, Bd. 154, s. 197–202, January 25, 1901. Dated Washington, December 5, 1900.
13. On the desirableness of a reinvestigation of the problems growing out of the mean motion of the moon. Monthly Notices, R. A. S., Vol. LXIII, 316–324, March, 1903. (This paper comprises a general résumé of the observations and investigations which show the reality of unexplained fluctuations of remarkable magnitude in the mean motion of the moon. It is believed that it was due to the appearance of this paper that the subject of inequalities produced by the action of the planets on the moon was proposed as an Adams prize essay. This prize was awarded to Prof. E. W. Brown Feb. 8, 1907.)
14. Investigation of inequalities in the motion of the moon produced by the action of the planets. Publication No. 72 of the Carnegie Institution of Washington, dated June, 1907. Hereafter referred to as "Action II."
15. La Théorie du Mouvement de la Lune, son histoire et son état actuel. Address before the International Congress of Mathematicians in Rome, April, 1908. Atti del IV Congresso Internazionale dei Matematici, Roma, 6–11 Aprile, 1908, Vol. I, pp. 135–143. (This is a discussion of the whole subject more complete than that published in 1903.)
16. Fluctuations in the moon's mean motion. Monthly Notices, R. A. S., Vol. LXIX, pp. 164–169, January, 1909. Dated Washington, December 11, 1908. (This is an abstract of the present work.)
17. Comparison of ancient eclipses of the sun with modern elements of the moon's motion. Monthly Notices, R. A. S., Vol. LXIX, pp. 460–467, March, 1909. (The basis of this paper is also formed by the results of the present work. Its purpose is to decide whether the ancient eclipses can be used for correcting the lunar elements, a point on which the author has generally differed from his fellow investigators.)

RESEARCHES ON THE MOTION OF THE MOON, PART II.

Chapter I.

INTRODUCTION.

1. We begin by presenting such statements of the purpose, methods, and contents of the present work as shall facilitate the mastery and criticism of its processes and conclusions. Taken in connection with the "Researches" of 1878, of which it is a continuation, the purpose of the work may be defined as primarily a determination of the moon's mean motion and its fluctuations of long period, by means of all available material not previously worked up by others. Practically the material is limited to eclipses and occultations. The reason for omitting meridian observations is twofold. The Greenwich observations of the last half century have been very fully discussed and their results worked out by Mr. Cowell, under the auspices of the Royal Observatory itself. The results have appeared in recent publications of the Royal Astronomical Society. The older Greenwich observations require to be reduced with modern data before they can be of much use. They are therefore practically unavailable at present.

The large difference known to exist between the personal equation in observing the limb of the sun or moon and a star renders meridian observations less suitable than occultations for detecting changes in the moon's mean motion. The result of this difference is that during periods of several consecutive years the mean longitude of the moon derived from meridian observations may be appreciably in error. Observations of occultations are comparatively free from this source of error, and are therefore most suitable for determining fluctuations of long period in the mean motion. Moreover, as this class of observations extends back more than 80 years before meridian observations are available, they afford a series of fairly uniform results extending through more than 230 years.

On the other hand, inequalities of short period can as a general rule be better determined from the meridian observations than from occultations. In this statement must be included the determination of the eccentricity and of the longitude of the perigee, taking for the latter its value at any recent epoch. But the motion of the perigee can not thus be well determined until the Greenwich meridian observations from 1750 to 1830 or 1840 are better reduced and compared with the tables than they have yet been. Observations of occultations being available since 1625, they are now essential in the determination, but may still lose importance when the data of meridian observations are complete. In the work already alluded to, Mr. Cowell has discussed the Greenwich observations of the last half century so completely that his results for the inequalities of short period seem to be definitive so far as present requirements are concerned. They still remain to be compared with Brown's theoretical determinations. Should any discrepancy be found too large to be accounted for by known causes, additional investigation may be required.

An exception to this is the parallactic inequality. Great interest attaches to this inequality because its accurate determination affords one of the most precise methods of determining the solar parallax. In this determination the numerical divisor of the inequality is nearly 15, so

that, possible theoretical uncertainty aside, the error of the parallax will be little more than one-fifteenth that of the inequality. It follows that if the latter can be determined from observations within the limits $\pm 0''.15$, the solar parallax will be determined within $\pm 0''.01$. But, in the case of the meridian observations, it is impossible to free the true value of the inequality from systematic errors varying with the position of the moon relative to the sun. From this cause it can hardly be expected that any such determination will be accurate to the degree mentioned. But, for the most part, observations of occultations are free from at least the larger part of this systematic error. The difficulty of dealing with them is, however, such that we can not in advance define the degree of precision, but we have good reason to believe that the result will be markedly better than that which can be derived from meridian observations.

2. The preceding remarks apply to the inequalities of the moon's motion in right ascension or longitude. In the case of the declination, meridian observations of the ordinary class are subject to a serious drawback of that troublesome character that may be called semi-systematic. This arises from the motion of the moon in declination. Although we habitually speak and think of an observer as observing the image of a star, or placing the thread of his instrument tangent to the limb of the moon at a definite moment of time, or when the object is in a definite position, such is practically never the case. Time is required for all mental operations, and the setting of a thread can never be the work of a moment. Practically it requires the work of a number of seconds, and the time will be longer the worse the image. In the case of a star or planet, or even of the sun, this is no drawback, because the accurate setting remains practically unchanged during a period of a number of seconds, and the skilled observer can arrange his setting to correspond to some mean and well determined moment. But, in the case of the moon, unless near the points of maximum or minimum declination, the motion in declination while the observer is deciding upon the tangency may be appreciable. It will commonly amount to an entire second near the equator. Under such circumstances personal error of a systematic character is unavoidable. The system of setting the thread in a fixed position and observing the time of transit of the limb over it might do away with the error in great part. But I do not think that this device has ever been adopted. Observations of occultations are completely free from this source of error and are therefore best adapted to determine the node and inclination of the lunar orbit.

3. A weighty consideration which offered to the author a strong inducement to undertake and carry through a work so onerous is that occultations afford a method of determining certain astronomical elements pertaining to the motion of the earth with possibly greater precision than does any other method. Making abstraction of the inequality in the moon's latitude arising from the oblateness of the earth, the mean orbit of the moon coincides with the ecliptic. The determination of the position of the latter in the usual direct way by observations of the sun is subject to large systematic errors arising from numerous causes, known and unknown, incident to diurnal changes of temperature. In reducing an observation of the sun the refraction is determined from the external temperature in the same way as in the case of a star at night. But owing to the very different law of temperature in the very different strata of air by day and by night, the same formulæ can not hold for the two cases, and the difference continually increases as we pass from the zenith to the horizon. In these different laws of temperature must be included the difference in the temperature inside and outside the observing room, and even inside and outside the tube of the instrument—we might say even the difference between the lower side and the upper side of the column of air in the tube itself, which is found to cause a quite measurable refraction within the tube. To this cause must be added others, the effect of which can not be determined, due to the action of the sun on the instrument and to the systematic difference, never admitting of determination, between the personal equation for the sun and for a star. An example of the uncertainty thus arising is seen in the very discordant results for the position of the ecliptic as determined at

Greenwich year after year, where the constancy of the conditions is such that we should suppose the results to be nearly the same, how much soever they might be affected by systematic error.

Observations of occultations are practically free from this source of systematic error. It is quite true that the position of the ecliptic determined from them will be affected by whatever corresponding systematic error may affect the positions of the stars. But, from the general uniformity of the conditions under which star determinations are made, the systematic errors are much less than those liable to affect observations of the sun. For this reason the present work includes the determination from occultations not only of the lunar node and inclination, but the position and motion of the equinox, or the common correction to the absolute right ascension of the stars, and the secular variation of the obliquity of the ecliptic. The obliquity itself can not be reliably determined owing to the uncertainty of the effect of the earth's oblateness.

In setting forth the advantages of occultations for the determinations in question, the writer does not desire to ignore a very serious drawback the importance of which can not be estimated except by a careful study of the finished work. This is the large probable error of the best observations as shown by the discordance between observations at different places and times. The main source of this error is probably to be found in the inequalities of the lunar surface. So far as purely fortuitous this error may be regarded as accidental and therefore admitting of almost complete elimination by increasing the number of observations. In the present work this number is so great that, theoretically, the result should be satisfactory.

But a study of the distribution of the residual errors in magnitude shows that, in common with most astronomical observations, this distribution does not follow the normal law of error, both large and small errors being more frequent than they should be if the law were followed. This feature is doubtless largely due to defects in the practice of observers. Without great care the disappearance of a star in the glare surrounding the moon's bright limb is liable to be mistaken for an actual occultation. We must therefore expect an undue number of errors of the same sign in this class of occultations. In the case of emersions, even at the dark limb, the observer may fail to catch the star at its actual instantaneous reappearance, and it may happen that the only method of detecting an error may be by the discordance of the result. It must be admitted that a conscientious and careful observer ought rarely to be at fault in such case without knowing it; how far this holds can be determined only by a study of results.

It is a curious psychological fact, which I have observed through the whole series of observations, that when an observer is conscious of having noted an immersion too soon, or an emersion too late, his estimate of the error may safely be multiplied many times, perhaps ten times on the average.

A seemingly fair method of eliminating all this class of errors is by having an occultation at one and the same station observed independently by several observers, as is generally done at Greenwich. Yet, a comparison of final results may show that all systematic errors are not thus avoided. Unfortunately, there are few other observatories than Greenwich at which occultations are habitually noted by more than one observer.

General Arrangement of the Work.

4. It seems essential to the usefulness of the work to the future investigator that it should be so arranged as to facilitate its criticism and correction. One method of doing this is to present as fully as possible the various steps of computation.

In publishing the former work, the tabular data and steps of computation were given with some fullness in the form of tabular exhibits. In the original plan of the present work it was intended to adopt the same policy, but after some consideration the author judged that the publication of so large a mass of matter as the separate data for some 4,000 occultations would render

cumbrous the study of the work, and that scarcely any case would be likely to rise in which a future investigator would deem it worth while to repeat the reduction of any one occultation out of so large a mass.

The repeated corrections which had to be made from time to time in the work as constants were changed, improved methods devised, and correction after correction applied, must all result in increasing the probable error of the constant terms in the equations. If, therefore, the work is ultimately to be revised and reconstructed by the future investigator, his best course will not be to attempt its repetition, but to proceed *de novo* so far as the absolute terms of the equations of condition are concerned. This is especially true with the numerous corrections of all kinds which have to be applied to Hansen's tables. It is not meant by this statement that these tables can not be the basis of a revision, and that new provisional ones should be substituted. The view taken by the author is that it will be advantageous to substitute a new system of corrections to Hansen's tables for the one he has used, to decide upon the best constants of the geoid, and then to repeat the computation of the absolute terms of the equations. The labor of doing this, if carried through systematically, will be much less than that of revising the whole work.

These remarks apply only to the absolute terms of the equations. The coefficients of the conditional equations are, the author believes, sufficiently accurate for all future purposes, occasional accidental errors aside. He adds that it will not be necessary even to repeat the computation of the coefficients of the normal equations, especially as these have been so arranged as to facilitate any new combination that may be desirable.

CHAPTER II.

ADOPTED METHODS AND FORMULÆ OF REDUCTION.

5. The essential features of the process employed by the author to derive an equation of condition from an observed occultation are to be mentioned. What the observation gives is, that at a certain moment of time, the apparent angular distance between the moon's center and the position of the occulted star is equal to the moon's apparent angular semidiameter. The processes of utilizing such an observation for determining corrections to the elements of the moon's motion are the following:

For the observed Greenwich mean time the tabular apparent position of the moon's center, as seen from the point of observation, is to be computed from the tabular data. The apparent position of the star being also computed, the tabular distance between the latter and the center of the moon is determined. The comparison of this distance with the apparent semidiameter of the moon gives the error of the tabular place projected upon the line joining the center of the moon and the star. Expressing this error in terms of errors of the various elements, an equation of correction is formed.

The formulæ and methods of computation are derived in the Researches of 1878, and are recapitulated in the present paper in their proper connection so far as is necessary for the understanding of the numerical processes. The principal steps of computation are the following:

(1) Computation of the geocentric spherical coordinates of the moon for the moment of observation expressed in Greenwich mean time. These are made originally from Hansen's tables or, since 1862, from the ephemeris given in the Nautical Almanac. (Generally from 1847 from the Nautical Almanac computations.)

(2) Computation of the corresponding geocentric coordinates of the observer for the same moment.

(3) With these relative coordinates of the moon and of the observer, the tabular apparent spherical coordinates of the former as seen by the latter are computed. Also the moon's semidiameter.

(4) Computation of the apparent position of the star. Before 1862 the coordinates of the moon and star are generally referred to the ecliptic; from and after that year to the equator.

(5) Computation from these apparent coordinates of the tabular distance between the center of the moon and the star.

(6) Computation of the differential coefficients by which the correction of the distance is expressed in terms of corrections to the various elements involved.

Reduction Using Ecliptic Coordinates.

For the period before 1862 it was found convenient in computing the moon's apparent position to reduce the coordinates of the observer upon the earth to the ecliptic, rather than to reduce the moon's ecliptic coordinates to the equator. This required that the position of the stars should be reduced from right ascension and declination to longitude and latitude. The labor of this transformation is partly compensated by the greater simplicity of the reductions to remote epochs, and to apparent place, when ecliptical coordinates are used. As occultations of the same star are often observed several times, the excess of labor is thus divided. It may be added that the computation of the coefficients for correcting the lunar elements is also simpler with ecliptical coordinates.

NOTE.—In the completion of the work at the Carnegie Institution use was made almost exclusively of the equatorial coordinates from Hansen's tables which are found in an appendix in the Monthly Notices, R. A. S., Vol. L.

The formulæ used in the reductions up to 1862 are derived with some fullness in the Researches of 1878. For convenience of reference they are here quoted:

6. *Apparent place of the moon.*—Put

r, l, b, the geocentric radius-vector, longitude, and latitude of the moon;
ρ, λ, β, the corresponding coordinates of the observer;
r', l', b', the corresponding coordinates of the moon as seen by the observer;
$R=\frac{r'}{r}$;
π, the moon's equatorial horizontal parallax;
ε, the obliquity of the ecliptic.

The values of λ and β are obtained from the observer's geocentric latitude and his local sidereal time by changing the right ascension and declination of his geocentric zenith into ecliptic longitude and latitude. Putting

φ', the observer's geocentric latitude;
τ, his sidereal time expressed in arc;

we compute u and k' from the formulæ

$$k' \sin u=\rho \sin \varphi',$$
$$k' \cos u=\rho \cos \varphi' \sin \tau.$$

Then $\rho \cos \beta$, $\rho \sin \beta$, and λ are given by

$$\rho \cos \beta \cos \lambda=\rho \cos \varphi' \cos \tau,$$
$$\rho \cos \beta \sin \lambda=k' \cos (u-\varepsilon)=\rho \cos \varphi' \cos \varepsilon \sin \tau+\rho \sin \varphi' \sin \varepsilon,$$
$$\rho \sin \beta \qquad =k' \sin (u-\varepsilon)=\rho \sin \varphi' \cos \varepsilon-\rho \cos \varphi' \sin \varepsilon \sin \tau.$$

In the Researches of 1878 Bessel's spheroid was adopted in the reductions for parallax. This series terminated with the year 1747. Afterwards when the work of reducing the observations since 1750 was undertaken, Clarke's determination of the figure of the earth had been published, and being supposed to supersede Bessel's, was temporarily adopted. A general revision of the constant was made by Listing, whose concluded result was[a]

$$\text{Compression}=1\div 288.48,$$

which was also employed. Thus three values of the compression were adopted in the preliminary work.

In 1903, when the revision and completion of the work was undertaken, it was found that the derivation of the compression from geodetic measures as made by Clarke, and presumably by Listing, was unreliable, owing to the irregularities in the direction of gravity in various regions of the earth, and that Bessel's value which rested on pendulum observations was probably better than the others. The value $1\div 298.26$ was communicated in writing by Professor Helmert as the most probable found up to 1903, and was therefore adopted as that to which all the results were to be reduced.

At the present time, 1908, the author would not be surprised should it ultimately be found that, after all, the Clarke value best expresses the actual compression of the geoid.

Having thus found the apparent coordinates of the observer, those of the moon may be derived by the equations:

$$R \cos b' \cos (l'-l)=\cos b-\rho \cos \beta \sin \pi \cos (l-\lambda),$$
$$R \cos b' \sin (l'-l)=\rho \cos \beta \sin \pi \sin (l-\lambda),$$
$$R \sin b' \qquad =\sin b-\rho \sin \beta \sin \pi.$$

[a] Neue geometrische und dynamische Constanten des Erdkörpers. Astronomische Nachrichten, Bd. 93, S. 318.

Knowing R, b', $l'-l$, and thence l', the apparent semidiameter of the moon, s', is found from the equation

$$\sin s' = \frac{k \sin \pi}{R}, \tag{1}$$

k being the ratio of the diameter of the moon to that of the earth. The semidiameter, s', is so small that we may suppose it equal to its sine, making the equation for its determination, in seconds,

$$s' = \frac{[5.31443]\ k \sin \pi}{R}. \tag{2}$$

The numerical value of k depends upon the adopted constant of lunar parallax, as well as upon the semidiameter of the moon. In the present work we have used

$$s_0 = 932''.58.$$

This with Hansen's constant of parallax gives

$$[5.31443]\ k = [4.74982].$$

But if, before the computation, we increase Hansen's parallax by 0''.40, the logarithm is 4.74977.

The value of k adopted in the original work was that of Oudemans, 0.27264. This gave

$$\left.\begin{aligned} \log k &= 9.43559, \\ s' &= \frac{[4.75002]\ \sin \pi}{R}, \end{aligned}\right\} \tag{3}$$

the parallax being Hansen's.

7. *Apparent place of the star.*—In the original work published in 1878, and in the continuation carried on during the next few years, the right ascensions and declinations of the stars were reduced to the ecliptic with Hansen's obliquity, and the reduction to the equinox of observation was made with the Struve-Peters precession. In the revised work begun in 1903, the positions of the occulted stars were mostly taken from the Catalogue of Standard Stars of 1897, and the Catalogue of Zodiacal Stars published by the office of the American Ephemeris in 1905. The positions for 1900 were reduced to the ecliptic, using the new value of the obliquity:

$$\varepsilon = 23°\ 27'\ 8''.26.$$

For the sake of convenient comparison with the older work, the ecliptical coordinates were then reduced to 1850.0, as the standard epoch.

We used the notation

L, the longitude of the star;

B, its latitude.

The precessional motions and the formulæ of reduction to apparent place are approximately those of the author as developed in his Compendium of Spherical Astronomy, §149. They are as follows, unity of time being the star century and the epoch 1850.0:

$$\left.\begin{aligned} \frac{dL}{dt} &= 5024''.53 + \mu_1 - 47''.14 \tan B \cos (L + 6°\ 30'), \\ \frac{d^2L}{dt^2} &= 2''.23 + 0''.40 \tan B \sin (L + 16°), \\ \frac{dB}{dt} &= 47''.14 \sin (L + 6°\ 30') + \mu_2, \\ \frac{d^2B}{dt^2} &= 0''.40 \cos (L + 16°). \end{aligned}\right| \tag{4}$$

Reduction for aberration:

$$\left.\begin{aligned} \varDelta L &= -20''.50 \cos(\odot - L) \sec B, \\ \varDelta B &= -20''.50 \sin(\odot - L) \sin B, \end{aligned}\right\} \tag{5}$$

$\odot$ being the sun's true longitude.

Nutation has been omitted in computing the places both of the moon and the star.

8. *Distance of centers of the moon and star.*—Having found by the preceding methods,

l', b', s', the apparent longitude, latitude, and semidiameter of the moon;

L, B, the longitude and latitude of the star;

the distance of centers, D, and the angle of position, m, of the line joining the centers are given by the equations

$$\left.\begin{aligned} D \sin m &= (l' - L) \cos \tfrac{1}{2}(b' + B), \\ D \cos m &= b' - B. \end{aligned}\right\} \tag{6}$$

These expressions are not rigorous, but the error is of no importance, because the angle m is never observed with such accuracy as to be used as a datum for correcting the moon's place, while the error in D is so small as to be entirely unimportant.

Reduction Using Equatorial Coordinates.

9. From the beginning of 1862 the right ascensions and declinations of the moon given in the hourly ephemeris of the Nautical Almanac were used in the reductions. The general plan of the reduction corresponded to that adopted in the case of the longitude. From the geocentric place of the moon as taken from the ephemeris was computed the apparent place of the center as seen by the observer, and the apparent semidiameter. The original reductions were made in the following way. Put

α, δ, the moon's geocentric R. A. and Decl.;
α', δ', its apparent R. A. and Decl. as seen by the observer;
H, its west geocentric hour-angle;
ρ, the radius of the earth at the point of observation;
φ', the geocentric latitude.

Compute

$$\left.\begin{aligned} p &= \rho \cos \varphi' \sin \pi, \\ q &= \rho \sin \varphi' \sin \pi. \end{aligned}\right\} \tag{7}$$

The apparent position, the factor R, and the semidiameter were then computed from the equations

$$\left.\begin{aligned} R \cos \delta' \sin(\alpha' - \alpha) &= -p \sin H, \\ R \cos \delta' \cos(\alpha' - \alpha) &= \cos \delta - p \cos H, \\ R \sin \delta' \qquad\qquad &= \sin \delta - q, \end{aligned}\right\} \tag{8}$$

$$s' = \frac{[4.75002] \sin \pi}{R},$$

or, with the semidiameter and parallax as finally adopted,

$$s' = \frac{[4.74977] \sin \pi}{R}.$$

To find the distance and position angle between the moon's apparent center and the star, we put α_1 and δ_1 for the apparent coordinates of the star. We then have, with sufficient precision,

$$\left.\begin{aligned} D \sin m_1 &= (\alpha' - \alpha_1) \cos \tfrac{1}{2}(\delta' + \delta_1), \\ D \cos m_1 &= \delta' - \delta_1. \end{aligned}\right\} \tag{9}$$

Having found D and m_1, the subsequent computation of the differential coefficients scarcely differs except in arrangement and order of quantities from that used in the longitudes.

Coefficients of the Equations of Condition for Correcting the Provisional Elements.

10. Heretofore observations of occultations have been used only for correcting the apparent position of the moon, and occasionally one or more of the lunar elements. But it will be of interest, and may prove of scientific value, to introduce a wider range of corrections, including certain elements pertaining to the position of the occulted stars as well as to the elements of the moon's motion. We have already mentioned the two drawbacks incident to meridian observations of the moon—the varying personal equation of the observers and the systematic error liable to arise in the observed declination through the rapid motion of the moon in declination. The latter introduces an element of uncertainty in the determination of the moon's node and inclination from meridian observations. The only two elements which we can confidently base entirely on this class of observations are the eccentricity and the perigee. Even in the case of the latter the motion may be defective because the meridian observations for determining it commenced with Bradley, and have not yet been satisfactorily worked up and discussed. Since accurate observations of occultations commenced about 80 years before Bradley's time, they can be used with advantage to determine the motion of the perigee.

Although not strictly an element, the parallactic inequality should be determined from observation. The reasons for this, and the principles on which other elements may be determined have been set forth in the preceding chapter.

To form the equations of condition for the corrections of the elements of reduction, we proceed thus: each observed occultation gives rise to a conditional equation of the form

$$s' - D = \Delta D, \tag{10}$$

where ΔD is the symbolic increment of D, which is to be expressed in terms of corrections to the various elements. To form this expression the derivatives of D with respect to the elements are to be formed. We regard the moon's parallax and the elements related to it as sufficiently well determined. Moreover, as the corrections to the geocentric longitude differ from those to the apparent longitude by a factor which at its maximum is only about 0.016, we regard the corrections $\Delta l'$ and $\Delta b'$ as equal to those of the moon's geocentric coordinates Δl and Δb.

The formulæ of correction are, in terms of coordinates,

(A) with ecliptical coordinates:

$$\Delta D = (\Delta l' - \Delta L) \cos B \sin m + (\Delta b' - \Delta B) \cos m. \tag{11}$$

(B) with equatorial coordinates:

$$\Delta D = (\Delta \alpha' - \Delta \alpha_1) \cos \delta' \sin m_1 + (\Delta \delta' - \Delta \delta_1) \cos m_1. \tag{12}$$

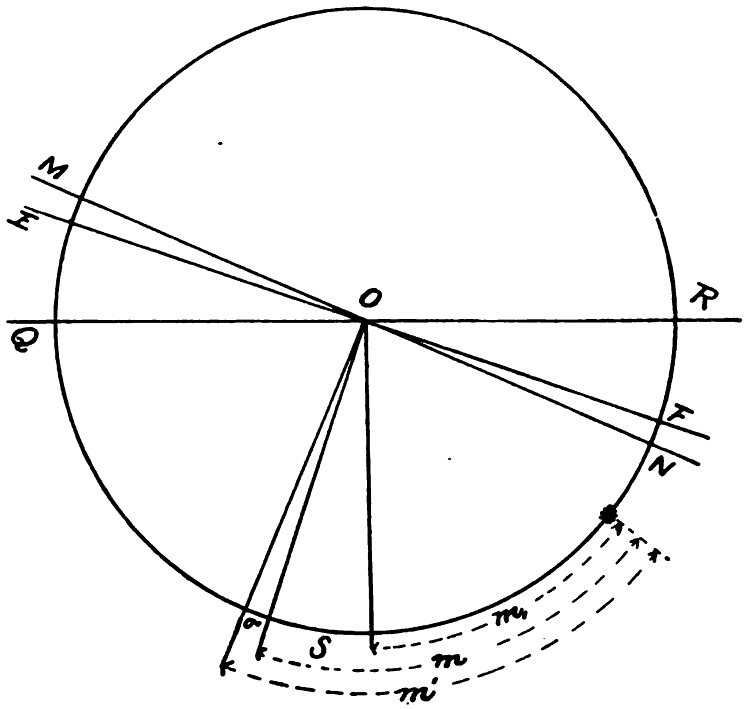
Practically, we may take $\cos B = 1$, and may take for δ' the declination of either the moon or the star, or their half sum.

(C) It is sometimes necessary to refer the corrections to the moon's longitude in orbit, v. We may then use

$$\Delta D = (\Delta v' - \Delta L) \sin m' + (\Delta \beta' - \Delta B) \cos m', \tag{13}$$

m' being the position angle corresponding to the plane of the moon's orbit, which is introduced in §12.

In any critical revision of the work it is necessary to distinguish clearly the three measures m, m_1, and m' of the position angle of the line joining the star and the center of the moon. The angles have already been fully defined; but their understanding will be facilitated by the accompanying diagram.



We have now to express these corrections to the coordinates of the two bodies in terms of corrections to the fundamental elements.

Corrections to the Coordinates of the Stars.

11. We regard the mean of all the corrections to the right ascensions and that of all the corrections to the declinations, as quantities varying uniformly with the time. Let us put

$\Delta\alpha$, this correction in right ascension;
$\Delta\delta$, this correction in declination;
$\Delta\varepsilon$, the correction to the obliquity of the ecliptic.

If we determine an angle S from either of the equations

$$\left.\begin{aligned}\sin S &= \cos\alpha \sec B \sin\varepsilon,\\ \sin S &= \cos L \sec\delta \sin\varepsilon,\end{aligned}\right\} \qquad (14)$$

we shall have

$$\begin{aligned}\cos B\,\Delta L &= \cos S \cos\delta\,\Delta\alpha + \sin S\,\Delta\delta + \sin B \cos L\,\Delta\varepsilon,\\ \cos B\,\Delta B &= -\sin S \cos\delta\,\Delta\alpha + \cos S\,\Delta\delta - \sin L\,\Delta\varepsilon.\end{aligned}$$

By substituting these values in (11) and putting, as we may, $\cos B = 1$, which gives

$$\sin S = \sin\varepsilon \cos\alpha,$$

we find

$$\begin{aligned}\Delta D = & -\sin(m-S)\cos\delta\,\Delta\alpha \\ & -\cos(m-S)\,\Delta\delta \\ & +(\cos m\sin L - \sin m\sin B\cos L)\,\Delta\varepsilon.\end{aligned}$$

We have, in (12)

$$m_1 = m - S.$$

Putting

$$h\sin H = \sin B\cos L,$$
$$h\cos H = \sin L,$$

we shall have

$$\Delta D = -\sin m_1\,\Delta\alpha - \cos m_1\,\Delta\delta + h\cos(m+H)\,\Delta\varepsilon. \tag{15}$$

Since

$$h^2 = \sin^2 L + \sin^2 B\cos^2 L,$$

we may put, when $\sin^2 B$ is dropped,

$$h = \sin L.$$

From $\tan H = \sin B\cot L$, we see that near the equinoxes H may approach 90°. But in this case h will become small, and the coefficient become unimportant, and may be dropped. In the second semicircle the argument becomes $L-180°$, and the signs of h and H are to be changed.

Coefficients of the Corrections to the Lunar Elements.

12. In the case of the corrections to the lunar elements, we first replace Δl and Δb by the corrections to the longitude in orbit, and to the latitude in a direction perpendicular to the plane of the orbit. We replace the position angle m by one counted from a perpendicular to this orbit as an origin by introducing the angle σ between the apparent orbit of the moon on the celestial sphere, and a parallel to the ecliptic. Then, putting $u=v-\theta$, the argument of latitude, we have

$$\sin\sigma = \sin i\cos u; \tag{16}$$

we compute

$$m' = m + \sigma,$$

and putting Δv, $\Delta\beta$ for the correction to the orbital longitude and latitude, we then have

$$\sin m\,\Delta l' + \cos m\,\Delta b' = \sin m'\,\Delta v + \cos m'\,\Delta\beta.$$

In terms of corrections to the elements and a constant error of any kind in the theoretical latitude, we have

$$\Delta\beta = \Delta i\sin u - i\Delta\theta\cos u + \Delta\beta_0. \tag{17}$$

Put

$\Delta\lambda$, the correction to the moon's mean longitude;
$\Delta\pi$, that to the longitude of the perigee;
ΔP, that to the parallactic coefficient.

For the corrections to the moon's longitudinal elements, we have

$$\Delta v = \Delta\lambda(1+2e\cos g) - 2\,e\Delta\pi\cos g + \Delta P\sin \mathrm{D}\ (g = \text{moon's mean anomaly}). \tag{18}$$

The equation (15) with the additional terms formed by substituting (17) and (18) in (11) or (13), as the case may be, will be the complete conditional equation having ΔD as its absolute

term. The coefficients of the unknown quantities in the expression for ΔD are found to be as follows, putting $F=1+2e\cos g$:

$$\left.\begin{array}{lll} \text{Coefficient of} & & \Delta\alpha_0=-\sin m_1 \cos\delta, \\ \text{"} & \text{"} & \Delta\lambda= F\sin m', \\ \text{"} & \text{"} & 2e\,\Delta\pi=-\sin m'\cos g, \\ \text{"} & \text{"} & \Delta P= \sin m' \sin \mathrm{D}, \\ \text{"} & \text{"} & \Delta i= \cos m' \sin u, \\ \text{"} & \text{"} & i\,\Delta\theta=-\cos m' \cos u, \\ \text{"} & \text{"} & \Delta\varepsilon= \sin L\cos(m+H), \\ \text{"} & \text{"} & \Delta\beta_0= \cos m', \\ \text{"} & \text{"} & \Delta\delta_0=-\cos m_1. \end{array}\right\} \tag{19}$$

F, the factor for reducing the correction of the mean longitude to that of the true, can generally be found most readily by taking for it the ratio of the rates of change of these two quantities in any unit of time; that is

$$F=\frac{D_t v}{D_t\lambda}.$$

The value thus found will not be rigorously equal to the other, but the difference is practically unimportant, and, withal, the second value is the better.

In the reductions where longitudes were used the motion in longitude for .01 of a day was computed. We then have

$$F=\frac{D_t l}{7'.906}.$$

In the preceding formulæ the coefficient $\Delta\varepsilon$ is expressed in terms of the ecliptical coordinates of the star. As these coordinates are not used after 1862.0, it will be convenient to express $\frac{d}{d\varepsilon}D$ in terms of equatorial coordinates. We then have

$$\frac{d}{d\varepsilon}D=\sin\alpha\cos m_1-\sin\delta\cos\alpha\sin m_1.$$

It is indifferent whether we take for α and δ the coordinates of the moon or those of the star. In the latter case, if the star is one of which many occultations are used, the expression may be reduced to a monomial. But in the present case the computation has been made in the preceding form unchanged, natural numbers being used.

As m, m_1, m' do not differ greatly in value, there will arise between the coefficients of $\Delta\alpha_0$ and $\Delta\lambda$ approximations to equality, as also between those of $\Delta\delta_0$ and $\Delta\beta_0$, which will weaken the separate determination of these quantities by the solution of the equations. We shall therefore introduce, instead of $\Delta\lambda$ and $\Delta\beta_0$, the linear combinations

$$\Delta\lambda'=\Delta\lambda-\Delta\alpha_0,$$
$$\Delta\beta_0'=\Delta\beta_0-\Delta\delta_0,$$

which may be done by the substitution

$$\Delta\lambda=\Delta\lambda'+\Delta\alpha_0,$$
$$\Delta\beta_0=\Delta\beta_0'+\Delta\delta_0;$$

we shall then have

$$\begin{aligned}
\text{Coefficient of } \Delta\lambda' &= F \sin m', \\
\text{“} \quad \text{“} \quad \Delta\beta_0' &= \cos m', \\
\text{“} \quad \text{“} \quad \Delta\alpha_0 &= F \sin m' - \sin m_1 \cos \delta, \\
\text{“} \quad \text{“} \quad \Delta\delta_0 &= \cos m' - \cos m_1.
\end{aligned}$$

The preceding expression of ΔD in terms of corrections to the elements of reduction are, of course, the same whatever system of coordinates is used in the reductions. When the ecliptic system is used, m is computed in the reductions, while m_1 is computed when the equatorial system is used. For dates posterior to 1862 the factor F may be most conveniently formed by taking the moon's apparent path and rate of motion on the celestial sphere, and deriving from them the position and angular speed in the apparent orbit. Putting

$$\gamma = S + \sigma,$$

the angle which the moon's orbit makes with a parallel to the equator, and

$$v' = D_t v,$$

the moon's motion in longitude, the value of v' and of γ may be derived from the data of the hourly ephemeris by the equations

$$\begin{aligned}
v' \sin \gamma &= D_t \delta, \\
v' \cos \gamma &= \cos \delta \, D_t \alpha.
\end{aligned}$$

The factor F is then computed by

$$F = \frac{v'}{32.9} = [8.483] \, v'.$$

Here the divisor 32.9 is the mean motion of the moon in seconds of arc per minute of time.

The formulæ for the differential coefficients now become

$$\begin{aligned}
m' &= m_1 + \gamma, \\
\frac{dD}{d\lambda} &= F \sin (m_1 + \gamma), \\
\frac{dD}{d\beta} &= \cos (m_1 + \gamma).
\end{aligned}$$

$\frac{dD}{di}$ and $\frac{dD}{id\theta}$ are then found by multiplying $\frac{dD}{d\beta}$ by $\sin u$ and $-\cos u$ as before.

Transformation of Published Reductions.

13. In several published series of occultations the symbolic expression of ΔD, in terms of corrections to the moon's coordinates, is computed and given. In these cases our problem is that of transforming these corrections into the corrections of the adopted elements. Among the series of this kind are those of Greenwich, Cambridge (Eng.), the Cape of Good Hope, and, for the period 1862–1876, the Radcliffe observations at Oxford. In these four cases the coefficients of correction to the right ascension and declination of the moon are given. Other published results may be utilized in much the same way, because the coefficient of the correction of the coordinates of the star is practically equal to that of the coordinates of the moon.

In the case of the Greenwich observations the results are presented in the following way. The notation used in the published volumes, expressed in terms of our own, is

$$\begin{aligned}
x &= \Delta\alpha, \text{ correction of moon's right ascension;} \\
y &= -\Delta\delta, \text{ correction of moon's N. P. D.;} \\
e &= \Delta\alpha_1, \text{ correction of star's R. A.;} \\
f &= -\Delta\delta_1, \text{ correction of star's north polar distance;} \\
m &= 1000\,\Delta\pi, \text{ factor of correction to the equatorial horizontal parallax;} \\
n &= 1000\frac{\Delta s}{s}, \text{ factor of correction of moon's semidiameter.}
\end{aligned}$$

There are other corrections introduced which we do not deem it necessary and practicable to take account of in the present work. In the case of each occultation an equation of condition is derived and expressed in a form which we may write

$$\Delta D = -h\times e'' - g\times f'' + h\times x'' + g\times y'' + [\pi]\times m - [s]\times n,$$

h, g, $[\pi]$ and $[s]$ being numerical coefficients given in the volumes of Greenwich observations. From the latter the position angle m_1 may be at once derived by either or both the equations

$$\sin m_1 = h \sec\delta,$$
$$\cos m_1 = -g;$$

γ and F may then be computed from the equations already given, using the motion of the hourly ephemeris of the moon. But the Greenwich volumes give the motion of α and $-\delta$ for a second of time. If we use these motions instead of referring to the ephemeris, the equations are

$$\begin{aligned}
v' \sin\gamma &= -D_t(\text{N. P. D.}), \\
v' \cos\gamma &= \cos\delta\; D_t(\text{R. A.}), \\
F &= \frac{v'}{0.548} = [0.261]\; v'.
\end{aligned}$$

Then we form $m' = m_1 + \gamma$ and proceed as before.

The same is true of the Cape observations except that declination is used instead of N. P. D., and instead of m and n the increments of π and s are expressed by the quantities p and s, where, with a sufficient approximation,

$$p = \frac{\Delta\pi}{\sin\pi}, \qquad s = \frac{\Delta s}{\sin s}.$$

The Cape equation may therefore, by using our Greenwich notation, be expressed in the form

$$\Delta D = h\,\Delta\alpha - g\,\Delta\delta - h\,\Delta\alpha_1 + g\,\Delta\delta_1 + 1000\,[\pi]p - 1000[s]s.$$

In the Radcliffe and Cambridge observations the results are given in the same form as in the case of Greenwich.

If we aim at rigor the parallactic corrections require special attention. At Greenwich, Oxford, and the Cape, the compression

$$a = \frac{1}{300}$$

has been adopted in the published reductions. We thus have, with Helmert's compression (page 18), for use in the formulæ (7),

$$\Delta a = +0.000\,020,$$

which gives

$$\Delta(\rho \sin\pi) = 0''.40 - 0''.06 \sin^2\varphi.$$

This correction to the local horizontal parallax is

$$\text{For England,}\quad \Delta(\rho \sin \pi)=0''.36,\quad m=+0.105;$$
$$\text{For the Cape,}\quad \Delta(\rho \sin \pi)=0''.38,\quad p=+0.111\div 10^3.$$

The semidiameter generally used in the Greenwich reductions is

$$1826 \text{ to } 1899,\quad s_0=934''.08 \text{ (Hansen), hence } n=-1''.60;$$
$$1900 \text{ and later,}\quad s_0=932''.65 \text{ (Struve), hence } n=-0''.07.$$

In the Cape reductions was used

$$s=[9.43559]\pi.$$

The constant of π in Hansen's tables being $3422''.23$, this gives

$$s_0=933''.04,\ \text{hence}\ s=-0''.49\div 10^3.$$

At Oxford Hansen's semidiameter was used, so that the value of m and n are the same as for Greenwich.

Chapter III.

REDUCTION OF HANSEN'S TABLES TO THE PROVISIONALLY ACCEPTED THEORY.

Section I.—Corrections to the Longitude.

14. The researches of the past 30 years have shown that the inequalities tabulated in Hansen's Tables de la Lune, and originally used as the theoretical basis of the present work, require a great number of small corrections and additions to reduce the results to the now accepted theory. It is necessary to collect and apply such of these corrections as would materially affect the results to be derived from the comparison with observations. It is not, however, necessary that rigorous numerical precision should be aimed at. Were such the case, it would practically be necessary to construct new tables of the moon. This necessity is evaded by the consideration that small periodic errors in the theory compared, especially if the period is short, will merge themselves with the errors of observation. A possible exception occurs in the case of those so related to the argument of the moon's elongation from the sun that the unequal distribution of the observations in the lunation would result in an error in the adopted coefficient leading to a systematic error in the conclusion. Cases of this sort have been pointed out by Cowell in his discussion of Greenwich observations of the moon. Without attempting to form a rigorous criterion to determine whether a given correction is necessary, the following general principles will serve to guide our decision:

(A) Every correction which amounts to a large fraction of the probable error of a single observation should be included. Applying this rule to individual terms a correction of 0''.3 would be unimportant in the case of a single observation. But the accumulated effect of a large number of such corrections may be frequently important. It is therefore advisable to introduce all corrections exceeding 0''.2. Many of these small corrections can be introduced without much additional labor.

(B) Up to a certain limit the longer the period of the correction the more important it will be, for the obvious reason that it will affect a longer series of observations in the same way. We may therefore make a distinction between the solar terms, of which the period is generally of the order of magnitude of a month, and the planetary terms, of which the period may be one or more years. In the latter case greater precision is required, but in the case of periods much exceeding that of the moon's node the correction again becomes less necessary, because it will be merged with the unknown inequalities of very long period in the mean longitude.

(C) The parallactic inequality being one which is to be determined from the observations, it is necessary that the coefficients related to it should be determined as accurately as possible.

These considerations lead to the division of the corrections into two classes. One comprises those of the longest period, which merge with those which have to be determined from observations alone, and which therefore need not be applied in advance. When the observed value of the fluctuations having a period greater than that of the moon's node are mapped out it can be determined by a comparison with the best theory what the outstanding residual correction is. We shall therefore consider in the present chapter only those terms which for the reasons above mentioned are to be applied in advance of the discussion. These corrections, so far as they could be determined, were constructed, tabulated, and applied in 1904, when Brown's lunar theory was still incomplete, and when the best determination of the planetary terms was that of Radau. After

this work was done Brown's completed theory appeared, and should supersede the corrections which had been used. Early in 1907 the author completed and published his reinvestigation of the action of the planets on the moon, which appeared in June of that year as Publication No. 72 of the Carnegie Institution. The tables were now reconstructed so as to reduce them to Brown's theory of the solar terms and my own computation of the planetary terms.

The foregoing considerations apply to periodic terms in the longitude. But it may be necessary also to correct some of the elements in advance. Of these the eccentricity and inclination of the moon's orbit are of secondary consideration because they can probably be better determined from meridian observations. The former has, however, been included. The semidiameter is excluded because it has been determined with all required precision by Peters and by Struve. The parallax is not included because its theoretical value for the mean radius of the earth is beyond serious doubt. Its value for special points of observation depends on the compression of the geoid; but the question whether the value of this constant can be determined from the occultations must be postponed to the end of the work.

Errors of short period will have no systematic effect on any of the elements to be determined, except the parallactic inequality, but will be merged with the accidental errors, which they will increase only when so large as to be an important fraction of their amount. So long as the average sum of all the theoretical errors of short period does not exceed $0''.3$, they will be of no importance in the present work.

Corrections of Long Period.

15. Were the inequalities of long period in the mean longitude determined by theory with unquestionable completeness and rigor, and did the result agree fairly well with observations, we should adopt the results of theory as the basis for the ephemeris of comparison. But as entire rigor in this respect can not be assumed at the time the present work is being carried on, it seems better to leave the question of the ultimate outstanding difference between theory and observation to be discussed when the former is brought as near as may be to completeness. Moreover, the discrepancy between theory and observation is, so far as yet appears, too large to admit of the convenient and precise determination of the unknown quantities of the equations unless an empirical correction is applied to the mean longitude so as to reduce the residuals left by observations. Under these circumstances the most eligible course seems to be to take the corrections, empirical and otherwise, to Hansen's tables, which have been applied in the Ephemerides since 1883, as the basis of the ephemeris of comparison. The corrections thus derived will be nearly but not rigorously identical with those derived and tabulated in the Researches of 1878, page 268. As used in the Ephemerides from 1883, the corrections of long period to Hansen's tables are as follows:

We put V_2 for the empirical Venus term, wrongly introduced by Hansen to represent observations. We also put A for the argument of the other Hansenian term, of which Hansen's coefficient is in error by approximately $1''$. Then

$$\begin{aligned} V_2 &= 21''.47 \sin (8V - 13E + 274^\circ\ 14'), \\ A &= 18V - 16E - g, \\ \text{Empirical term} &= -15''.5 \cos A. \end{aligned}$$

The total secular correction to Hansen's mean longitude, long-period terms included, which has been used in the Ephemerides since 1883, then becomes

$$\delta\lambda = -V_2 - 1''.14 - 29''.17\ T - 3''.76\ T^2 - 15''.5 \cos A. \tag{20}$$

The most convenient way of applying this correction is to omit Hansen's Table XLI and to replace it by the sum of the above terms, omitting the first. We may tabulate the sum thus found as a function of the time. Since Hansen's Table XLI contains the constant $21''.49$, which

will be omitted with the table, this constant must be applied in the new table. If this process is followed, the quantity by which to replace Table XLI is

$$20''.35 - 29''.17\ T - 3''.76\ T^2 - 15''.50 \cos A. \tag{21}$$

When the longitude is first computed from Hansen's tables unchanged, the original correction (20) is to be used. Its value is tabulated for 10-year intervals in the following scheme, where column C gives the value of $-1''.14 - 29''.17\ T - 3''.76\ T^2$.

Corrections of Long Period and Secular Corrections to Hansen's Mean Longitude.

Year.	Arg. A.	$-V_2$	$-15''.5 \cos A$	C	$\delta\lambda$
	°	''	''	''	''
1630	319.63	+18.67	−11.81	+37.58	+44.44
1640	332.82	+20.78	−13.79	+35.90	+42.89
1650	346.01	+21.46	−15.04	+34.16	+40.58
1660	359.20	+20.66	−15.50	+32.33	+37.49
1670	12.39	+18.45	−15.14	+30.43	+33.74
1680	25.58	+14.98	−13.98	+28.46	+29.46
1690	38.77	+10.45	−12.08	+26.40	+24.77
1700	51.96	+ 5.22	− 9.54	+24.27	+19.95
1710	65.15	− 0.38	− 6.51	+22.06	+15.17
1720	78.34	− 5.94	− 3.13	+19.79	+10.72
1730	91.53	−11.10	+ 0.41	+17.44	+ 6.75
1740	104.72	−15.49	+ 3.94	+15.01	+ 3.46
1750	117.91	−18.82	+ 7.26	+12.51	+ 0.95
1760	131.10	−20.85	+10.17	+ 9.93	− 0.75
1770	144.29	−21.45	+12.59	+ 7.27	− 1.59
1780	157.48	−20.58	+14.32	+ 4.55	− 1.71
1790	170.67	−18.28	+15.29	+ 1.74	− 1.25
1800	183.86	−14.73	+15.46	− 1.14	− 0.41
1810	197.05	−10.17	+14.82	− 4.10	+ 0.55
1820	210.24	− 4.92	+13.39	− 7.12	+ 1.35
1830	223.43	+ 0.68	+11.26	−10.23	+ 1.71
1840	236.62	+ 6.23	+ 8.53	−13.41	+ 1.35
1850	249.81	+11.35	+ 5.35	−16.66	+ 0.04
1860	263.00	+15.71	+ 1.89	−19.99	− 2.39
1870	276.19	+18.97	− 1.67	−23.40	− 6.10
1880	289.38	+20.93	− 5.14	−26.89	−11.10
1890	302.57	+21.46	− 8.34	−30.44	−17.32
1900	315.76	+20.50	−11.10	−34.07	−24.67
1910	328.95	+18.14	−13.28	−37.78	−32.92

Corrections of Mean Period.

16. Under this head we first include terms in which the argument contains the longitude of the moon's node and which arise from the compression of the earth and the motion of the ecliptic. Although most of these terms are of short period in the longitude, they arise from changes in the elements having periods of the order of magnitude of the time of revolution of the node. In Hansen's tables these terms are

$$n\delta z = +7''.760 \sin (\Omega - 4^\circ\ 42') - 0''.035 \sin 2\,\Omega$$
$$-0''.128 \sin (g+\Omega) + 0''.128 \sin (g-\Omega).$$

For the purpose of comparison these terms in the mean anomaly must be transformed into terms of longitude. The transformation gives

$$\delta l = +7''.594 \sin \Omega - 0''.636 \cos \Omega - 0''.035 \sin 2\,\Omega$$
$$+0''.30 \sin (g+\Omega) - 0''.30 \sin (g-\Omega).$$

I shall take Hill's investigation of the inequalities due to the compression of the earth[a] as the basis of the provisional theory. The terms found by Hill of a magnitude to be considered are

$$\begin{aligned}\delta l = &+7''.671 \sin \Omega - 0''.040 \sin 2\Omega \\ &+0''.520 \sin (g+\Omega) - 0''.519 \sin (g-\Omega) \\ &+0''.096 \sin (2D+\Omega) - 0''.064 \sin (2D-\Omega).\end{aligned}$$

Hill has also computed the terms produced by the motion of the ecliptic and found from this source

$$\delta l = 0''.029 \sin \Omega - 0''.285 \cos \Omega.$$

My own result of 1907 is

$$\delta l = 0''.030 \sin \Omega - 0''.273 \cos \Omega.$$

The terms depending on ☊ become

$$7''.701 \sin \Omega - 0''.273 \cos \Omega.$$

Omitting minute terms of period so short as to be unimportant, we find that the true longitude of Hansen's tables requires the following corrections depending on ☊ to reduce it to the provisional theory.

$$\begin{aligned}\delta l = &+0''.107 \sin \Omega + 0''.363 \cos \Omega \\ &+0''.22 \sin (g+\Omega) - 0''.22 \sin (g-\Omega).\end{aligned}$$

Reduced to a monomial the first two terms are

$$\delta l = 0''.378 \sin (\Omega + 73^\circ.6).$$

The Jovian Evection and Similar Terms.

17. The most important theoretical correction still needed to Hansen's tables is the Jovian evection. This is related to the preceding terms in a way to add interest to the history of its discovery. In 1875 the present writer published a discussion of the corrections required to Hansen's Tables de la Lune, both from theory and observation. When the corrections to the eccentricity and perigee were worked out, they were found to be affected with a well-marked fluctuation in a period of about 17 years. The resulting coefficient in the longitude as found from the observations was 1''.50. The discussion gave the correction of longitude

$$\delta l = 1''.50 \sin [g + 21^\circ.6 (t - 1865.1)].$$

Shortly after this publication Neison showed that this inequality was mainly due to the action of Jupiter in the same way that the ordinary evection is due to the action of the sun. From theory he found for the term[b]

$$\delta l = -1''.16 \sin (2\pi - 2J + g),$$

J being the mean longitude of Jupiter and π that of the moon's perigee.

In 1885 Hill published a very careful recomputation of this and the related terms, leading to the result

$$\delta l = -0''.903 \sin (2\pi - 2J + g).$$

[a] Astronomical Papers of the American Ephemeris, Vol. III, Part II.
[b] Monthly Notices, R. A. S., Vol. XXXVII, pp. 248, 358.

Radau reduced the coefficient still farther to $0''.881$, a value little more than half that found from observation.[a]

In 1904 Dr. Frank E. Ross, research assistant of the Carnegie Institution, working under the writer's direction, made a computation of the action of Jupiter on the moon, using the moon's coordinates as affected by the action of the sun. The result was the discovery of certain important terms due to the indirect action of Jupiter, and omitted by Hill and Radau, which carried the coefficient up to $1''.15$. This result is verified by me in the work of 1907.

An important point in this connection is that the annual motion of the argument $2J-2\pi$ differs by only $1°.31$ from that of the moon's node. The result is that the terms depending on the node and this argument will combine themselves together during a space of many years, and a cycle of 274 years will be required to complete the separation of the effects. The result is best shown by treating both terms as inequalities of long period in the eccentricity and perigee. If we express the effect on the longitude of the moon in the form

$$\delta l = h \sin g + k \cos g,$$

where $h=2\delta e$ and $k=-2e\,\delta\pi$, the values of h and k for the Jovian evection, and for the corresponding correction to Hansen's terms depending on ☊ are, from theory,

$$h=-1''.15 \cos(2\pi-2J),$$
$$k=-1''.15 \sin(2\pi-2J)+0''.44 \sin ☊.$$

With the last term of k may be combined the inequality of π arising from the motion of the ecliptic and planetary action derived in "Action II,"

$$\delta\pi=-0''.10 \sin ☊ + 0''.80 \cos ☊.$$

This gives the terms

$$+0''.01 \sin ☊ - 0''.09 \cos ☊,$$

in k, making the entire term

$$+0''.45 \sin ☊ - 0''.09 \cos ☊.$$

The numerical values of the arguments are

$$☊ = 146°.20 - 19°.3415\,(t-1850.0),$$
$$2\pi-2J = 239°.85 + 20°.6550\,(t-1850.0).$$

The amplitude of k reaches nearly its maximum when

$$2\pi-2J+☊=0,$$

which was the case in 1830. In 1825 and 1834, k reached maxima numerical values of $-1''.59$ and $+1''.59$, respectively. In 1898 the apparent augmentation of the Jovian evection vanished, to give place to a diminution in subsequent years, the minimum being reached in 1967.

Certain other terms of period approximating to that of the node, omitted by Hansen, but computed by subsequent authorities, may be associated with these. The most important as computed by Radau and by the author are

	Radau.	Newcomb.
$\delta l=$	$+0''.206 \sin(2\pi-2J)$	$+0''.256 \sin(2\pi-2J)$
	$+0''.194 \sin(2\pi-3J+267°.5)$	$+0''.258 \sin(2\pi-3J+268°.2)$
	$+0''.316 \sin(2\pi-3J+g+267°.5)$.	$+0''.445 \sin(2\pi-3J+g+268°.0)$.

The inequality containing g in its argument is most easily expressed by adding to h and k the terms

Radau.	Newcomb.
$h=0''.316 \cos(2\pi-3J+267°.5)$,	$h=0''.445 \cos(2\pi-3J+268°.0)$,
$k=0''.316 \sin(2\pi-3J+267°.5)$,	$k=0''.445 \sin(2\pi-3J+268°.0)$.

[a] "Recherches concernant les Inegalités Planétaires du Mouvement de la Lune" Annales de l'Observatoire de Paris, Memoires 21, p. B 113.

The value of the argument is

$$2\pi-3J=179^\circ.4-9^\circ.6940\ (t-1850.0).$$

Terms of similar period due to the action of Jupiter, Mars, and Venus, as computed by the author, are

$$\begin{aligned}\delta l=&+0''.183\sin(J+22^\circ.5)\\ &+0''.372\sin(2M-g'+328^\circ.7)\\ &+0''.095\sin(4M-2g'+89^\circ)\\ &+0''.072\sin(2\pi+3V-5g'),\end{aligned}$$

where M, V, J, and π are measured from the earth's perihelion for 1800, ($\pi'=99^\circ.5$), and g' is the sun's or earth's mean anomaly. The only corresponding inequalities in Hansen's tables are

$$\begin{aligned}\delta l=&+0''.320\sin(2M-g'+328^\circ)\\ &+0''.099\sin(4M-2g'+87^\circ).\end{aligned}$$

The following inequalities produced by Venus, were computed by Radau and by Brown, but not by the writer:

$$\begin{aligned}\delta l=&+0''.13\sin(2D-g+21E-20V+273^\circ)\\ &+0''.11\sin(g+29E-26V+112^\circ).\end{aligned}$$

Planetary Terms of Short Period.

18. The following inequalities of shorter period, some of which have been omitted by Hansen, may be deemed worthy of application:

Action of Venus.

Newcomb.	Hansen.
$\delta l=-0''.88\sin(V-g')$	$-1''.10\sin(V-E)$
$+0''.40\sin 2(V-g')$	$+0''.43\sin 2(V-E)$
$-0''.04\sin 3(V-g')$	$-0''.07\sin 3(V-E)$.
$+0''.35\sin(2V-3g'+164^\circ.3)$	
$+0''.20\sin(3V-4g'+168^\circ.3)$	
$-0''.65\sin(g+2\pi+3V-5g')$.	

Neglecting terms of short period less than 0''.20, it seems that by putting, for brevity,

$$L=V-g'=V-E,$$

we have the following terms of correction to Hansen depending on the arguments L and g':

$$\begin{aligned}\delta l=&+0''.22\sin L\\ &+0''.35\sin(2L-g'+164^\circ.3)\\ &+0''.20\sin(3L-g'+168^\circ.3).\end{aligned}$$

The term depending on the argument $g+2\pi+3V-5g'$ may most conveniently be developed as an inequality of h and k with a period of nearly 10 years. A number of other small terms ranging between 0''.10 and 0''.23 are collected later.

The remaining terms included by Hansen are

Action of Mars.

Newcomb.	Hansen.
$\delta l=+0''.011\sin(g'-M)$	$+0''.031\sin(E-M)$
$+0''.224\sin 2(g'-M)$	$+0''.241\sin 2(E-M)$
$+0''.372\sin(2M-g'+329^\circ)$	$+0''.320\sin(2M-E+228^\circ)$
$+0''.095\sin(4M-2g'+89^\circ)$	$+0''.099\sin(4M-2E+248^\circ)$

Action of Jupiter.

Newcomb.	Hansen.
$\delta l = +0''.74 \sin (g' - \text{J} + 1^\circ.2)$	$+0''.74 \sin (\text{E} - \text{J})$
$-0''.24 \sin 2(g' - \text{J})$.	$-0''.24 \sin 2(\text{E} - \text{J})$.

None of these six terms needs correction.

Solar Terms of Short Period.

19. Among all the errors of Hansen's tables the most troublesome is that of the parallactic equation. The original theory started with certain numbers which he afterward found to correspond to a solar parallax of 8″.6085. On this basis Hansen found for the parallactic term in $n\delta z$, the mean longitude, a theoretical coefficient of

$$-121''.368.$$

By comparison with observations he found that this coefficient should be multiplied by the factor

$$1.03573,$$

thus changing the coefficient by 4″.336 and carrying it to

$$-125''.704.$$

This increase is nearly double that given by observation.[a]

To facilitate the discussion of the corrections we compare the Hansenian tabular coefficients of the four principal parallactic terms with the values found by Delaunay and by Brown as follows:

Table of Parallactic Terms.

Theory of Hansen's tables.				Delaunay.	Brown.
Arg	$n\delta z$	δv	$1.03573\ \delta v$	$\pi = 8''.78$	$\pi = 8''.78$
	″	″	″	″	″
D	−121.368	−122.065	−126.43	−124.42	−124.78
D+g'	+ 17.489	+ 17.524	+ 18.15	+ 18.14	+ 17.99
D−g	− 11.692	− 18.490	− 19.15	− 18.82	− 18.55
D+g	− 1.614	− 8.244	− 8.54	− 8.56	− 8.44

It appears that there is a substantial agreement between Hansen and Delaunay as to the theoretical value of the minor parallactic terms corresponding to a given value of the solar parallax, except in the case of the argument D−g. Here the subsequent computation by Hansen, found in his Darlegung, gives a coefficient numerically less by 0″.292 than that of the tables. This brings his theory into better agreement with Brown, which last shows a large coefficient of correction, 0″.60, to the tables.

As a definitive theoretical value of the parallactic inequality was not established with numerical rigor when this work was commenced, I provisionally applied a diminution of 1″.60 to Hansen's implicit coefficient of the inequality in ecliptic longitude, reducing it to −124″.83, a value corresponding to a value of the solar parallax of about 8″.783. Applying the corresponding increment to the three other terms of Brown's theory, the total adopted correction is

[a] A portion of the error may be conjecturally accounted for on the theory that Hansen took the coefficient of the term in the ecliptic longitude, which is greater by 0″.7 than that in $n\delta z$, as if it were applicable to the latter.

$$\begin{aligned}\delta P = &+1''.60 \sin D \\ &-0''.15 \sin (D+g') \\ &+0''.59 \sin (D-g) \\ &+0''.10 \sin (D+g)\end{aligned}$$

Annual Equation.

20. For this we have

	″
Hansen (tables)	$-669.90 \sin g'$
Reduction to 1850	$+\ \ 0.83 \sin g'$
Factor, .000154	$-\ \ 0.10 \sin g'$
Hansen (tables, 1850)	$-669.17 \sin g'$
Brown	$-668.94 \sin g'$
Correction to Hansen	$+\ \ 0.23 \sin g'$

Evection and Variation.

The variation is closely associated with the parallactic inequality, because an error in the one will affect the determination of the other from observation unless observations are equally numerous on both sides of the moon's quadratures, which is not the case. It is well known that Hansen multiplied these and the other inequalities in the moon's longitude by the factor 1.0001544 on account of a supposed noncoincidence of the moon's center of gravity and of figure. I have shown that this correction is not well founded and that the apparent augmentation of the two largest inequalities grew mainly out of the fact that Hansen's theoretical value of the coefficient of evection was too small because his eccentricity was too small. Also that the value of the variation derived from meridian observations is too large through excess of the apparent semidiameter of the moon from first to last quarter over the semidiameter from last to first quarter, which excess is due to irradiation. It is therefore necessary to reduce the coefficients of evection and variation adopted in Hansen's tables to their theoretical values.

For the theoretical variation in ecliptic longitude we have:

	″
Hansen's original tabular theory	2369.77 sin 2D
As used in tables, with increase	2370.13 sin 2D
Theory in Darlegung	2369.75 sin 2D
Delaunay's theory	2369.74 sin 2D
Brown's theory	2369.90 sin 2D

In "Action II" an increment of 0″.02 is derived from the action of the planets. The tables therefore require the correction

$$\delta l = -\ 0''.21 \sin 2D.$$

The theoretical evection contains the eccentricity as a factor. Hansen's coefficient was computed with a value of e less by 1″.15 than that finally introduced in the tables; but the tabular value was not increased to correspond, as it should have been. In the theory on which the tables were based, the value of the coefficient of evection in ecliptic longitude was 4585″.978. This having been multiplied by 1.0001544, we have Hansen's actual tabular value, 4586″.68. The correct theoretical value depends on the eccentricity. Using the value of this element as corrected by Cowell from observations, we shall have:

	″
Theory of Hansen's Darlegung	$4586.42 \sin (2D-g)$
Theory of Delaunay	$4586.30 \sin (2D-g)$
Theory of Brown	$4586.42 \sin (2D-g)$
Action of planets	$+0.04 \sin (2D-g)$

In "Action II" a correction of $+0''.036$ is derived from the action of the planets. The definitive correction to Hansen's Tables for this term is therefore

$$\delta l = -0''.22 \sin (2D - g).$$

Miscellaneous Terms.

21. The preceding terms of short period are mostly large ones which require special adjustments to the revised values of the elements. The question now arises whether there are other solar terms which require important correction to reduce them to Brown's theory. An examination of Brown's comparison of his results with those of Hansen[a] shows only the following terms to be corrected:

	$''$
Hansen (tables)	$\delta l = +206.49 \sin (g - 3g' + 2\pi - 2\pi')$
Delaunay	$\delta l = +206.34 \sin (g - 3g' + 2\pi - 2\pi')$
Brown	$\delta l = +206.22 \sin (g - 3g' + 2\pi - 2\pi')$
Hansen (tables)	$\delta l = -\ 1.54 \sin (\pi - \pi')$
Hansen (Darlegung)	$\delta l = -\ 1.33 \sin (\pi - \pi')$
Delaunay	$\delta l = -\ 0.87 \sin (\pi - \pi')$
Brown	$\delta l = -\ 1.09 \sin (\pi - \pi')$

Here π' is the longitude of the solar perigee. When the earth's perihelion is used the sign is to be changed. The corrections in question thus become

$$\begin{aligned} \delta l = & - 0''.27 \sin (g - 3g' + 2\pi - 2\pi') \\ & + 0''.45 \sin (\pi - \pi'). \end{aligned}$$

The last of these may be classified with the terms of mean period, which will be tabulated as a function of the time.

Hill has also a term arising from the ellipticity of the earth,

$$\delta l = 0''.390 \sin (2g + 2\pi - \Omega),$$

as to the use of which I am in doubt. Its shortness of period renders it unnecessary to take account of it.

Erroneously Tabulated Term.

There is yet another correction of short period, related to the reduction to the ecliptic, which is to be applied to the positions of the moon given in the ephemerides from 1862 to 1882, and which arises in the following way: Hansen found, in his theory, a term

$$\delta l = -0''.335 \sin (2g - 4g' + 2\omega' - 4\omega')$$

which he includes in Table XXXIV as an inequality of $n\delta z$, but which he accidentally used with the positive sign. In the Darlegung he found a coefficient of $0''.285$. Hence the tables require the correction

$$\delta l = 0''.62 \sin (2g - 4g' + 2\omega - 4\omega')$$

A revised Table XXXIV, in which this correction was incorporated, was printed and circulated by the office of the American Ephemeris in 1878, and used in the national ephemerides from 1883. It was also used in the present work from the beginning till 1861.

Correction of the Perigee.

22. When the tables for the preceding corrections were prepared it was supposed that the error of the moon's perigee was so small that it was not necessary to introduce any correction as pre-

[a] Monthly Notices, R. A. S., Vol. LXV, pp. 276–296, January, 1905.

liminary to the equation, but the researches of Cowell seem to show the advisability of introducing this correction in advance. He applies to Hansen's perigee the preliminary correction

$$\delta\pi = -4''.63 + 13''.99T - 4''.74T^2 \text{ (1800).}$$

To this he finds from a general discussion of the early and later Greenwich observations the correction

$$\delta\pi = -2''.9 - 1''.0T + 7''.4T^2,$$

making the total correction to Hansen's longitude of the perigee

$$\delta\pi = -7''.5 + 13''.0T + 2''.7T^2. \qquad (22)$$

The term in T^2 has a well determined theoretical value best derived from Brown's expressions, from which we obtain the following results:

	$''$
Sidereal term	$-38.13T^2$
Equinoctial term	$+\ 1.11T^2$
Total	$-37.02T^2$
Hansen's term	$-36.19T^2$
Actual correction	$-\ 0.83T^2$
Correction to Cowell	$-\ 3.5T^2$

The coefficients have all been reduced to 1850, from which epoch T is reckoned.

This correction will have a material influence upon the motion to be derived from the observations, the amount of which depends upon the epoch at which Cowell's coefficient of T has the maximum weight. I assume this epoch to be 1875.

By differentiating (22) we find that the correction to Hansen's centennial motion found by Cowell has the general form

$$D_t\delta\pi = +13''.0 + 5''.4T;$$

T is counted from 1800.0. It follows that the correction to Hansen's centennial motion found by Cowell for this epoch is $+\ 17''.0$ at the epoch 1875. By differentiating the correction $-\ 0''.83T^2$ found by theory, we find that in order to produce the preceding value for 1875 the general form of the correction is

$$D_t\delta\pi = 18''.2 - 1''.66T,$$

and the actual correction to the longitude of the perigee as it results from Cowell's work may be taken as

$$\delta\pi = -\ 9''.4 + 18''.2T - 0''.83T^2.$$

The values for special epochs are as follows:

Year.	$\delta\pi$	$2e\delta\pi$
	$''$	$''$
1675	-33.4	-3.7
1700	-28.4	-3.1
1750	-18.7	-2.1
1800	$-\ 9.4$	-1.0
1850	$-\ 0.5$	-0.1
1900	$+\ 8.0$	$+0.9$

This correction is so large that I have tested it by a rough least-square solution of the 66 good equations of condition found in Researches, pages 226–230, which lead to the result

$$\textit{circa } 1700; \quad \delta\pi = +\ 8'' \pm 7''.$$

This is so incompatible with Cowell's result that I apply no preliminary correction to π.

Correction of the Eccentricity.

The correction to the coefficient of the equation of the center found by the author[a] is

$$2\delta e = -0''.57.$$

In deriving this result I overlooked a point recently brought out by Cowell, that the unequal distribution of the observations through a lunation will lead to an error in δe in case the tabular terms depending on $D+g$ and $D-g$ are incorrect. From Cowell's work it would seem that the correction $2\delta e$ is about $-0''.65$. Battermann, in two important researches, to be discussed later, has found from occultations a seemingly much larger value of the negative correction, namely

$$1884.3-1885.7;\ 2\delta e = -1''.10.$$
$$1894.8-1897.0;\ 2\delta e = -0''.90.$$

But an examination of the table of mean-period inequalities of $2\delta e$, or of h, shows that these are in good agreement with Cowell's mean correction.

	1884–1885.	1894–1897.
	$''$	$''$
Inequality of $2\delta e=h$	−0.45	−0.33
Cowell's constant	−0.65	−0.65
Apparent correction	−1.10	−0.98

As these provisional corrections are not intended as the basis of a theory, but only to bring the tables into as near an accord with observations as is practicable, I have accepted Cowell's result,

$$\delta l = -0''.65 \sin g,$$

as a correction to Hansen's tabular ecliptic longitude.

SECTION II.—CORRECTIONS TO THE LATITUDE, SEMIDIAMETER, AND PARALLAX.

The Latitude.

23. The most important deviation of Hansen's tabular latitude from pure theory consists in the constant correction of $-1''.00$ to the latitude on account of a supposed noncoincidence of the centers of gravity and figure of the moon. It seems probable that the seeming necessity for this correction arose partly because Hansen used too small a value of the moon's parallax, and partly from systematic errors in the observations of declination with which his comparisons were made. Owing to the serious doubt which may be entertained of the reality of the correction, it seems advisable to take it out, leaving the question involved in it for determination by equations of condition. This course is the more advisable from the correction being so easily made. We shall therefore apply to the provisional comparisons the constant correction

$$\delta\beta = +1''.0.$$

In "Action II," section 67, page 138, I have found the following terms in the combined effect of the motion of the ecliptic and the action of the planets upon the moon's node and inclination:

$$\delta\Omega = +(2''.55-0''.24\mathrm{T}) \sin \Omega - (17''.33+0''.01\mathrm{T}) \cos \Omega,$$
$$\delta i = -(0''.228-0''.022\mathrm{T}) \cos \Omega - (1''.538+0''.002\mathrm{T}) \sin \Omega,$$

T being reckoned from 1800. These give the inequality of the latitude

$$\delta\beta = -(0''.228-0''.022\mathrm{T}) \sin v + (1''.546+0''.002\mathrm{T}) \cos v,$$

[a] Astronomical Papers of the American Ephemeris, Vol. I, p. 69.

v being the true longitude in orbit of the moon. The argument v is also that of a term due to the ellipticity of the earth of which Hill's value is equivalent to

$$\delta\beta = -8''.726 \sin v.$$

Applying to this the terms just found we have as a result of theory,

$$\delta\beta = -8''.954 \sin v + 1''.546 \cos v$$
$$+(0''.022 \sin v + 0''.002 \cos v)T.$$

The corresponding term in Hansen's tables is

$$\delta\beta = +8''.764 \sin (v + 169^\circ\ 51')$$
$$= -8''.627 \sin v + 1''.544 \cos v.$$

Thus the theoretical correction to the tabular latitude is

$$\delta\beta = -(0''.327 - 0''.022T) \sin v;$$

but the correction is doubtful by its entire amount owing to the uncertainty of Hill's value of the earth's radius of gyration, and need not be considered until after the comparison with observations. Its effect on the moon's declination is practically the same as that of a correction to the tabular obliquity of the ecliptic.

Hansen cites, but does not tabulate, a secular variation equivalent to

$$\delta\beta = +0''.039T \sin v + 0''.005T \cos v,$$

which is nearly twice as great as that given above. The latter is too small to demand consideration in the present connection.

Cowell finds a correction of $-0''.30$ to Hansen's inclination.[a] This is presumptively real, but it is not necessary to apply it in the present work.

As to the value of $\delta\beta$ to be used, we remark that the only correction which we apply in advance to the ecliptic latitude is

$$\delta\beta = +1'' + \sin i \cos (v - \Omega)\delta l.$$

When we use m' the second term of this expression is unnecessary, its effect being included in the correction Δv. The preliminary correction of β actually required is the constant $+1''$ simply. This is in strictness applicable only to the ecliptic latitude, because it is from this latitude that Hansen's tables subtract the constant. But it may without appreciable error be applied in the direction at right angles to the plane of the orbit, and therefore used for $\delta\beta'$.

The correction of D for the obliquity may be easily computed by using the coefficient of $\Delta\varepsilon$ in the equations of condition. But as we shall hereafter find it convenient to compute separate values of $\Delta\varepsilon$ for various groups of the equations of condition, this correction may in most cases be omitted and applied to the respective values of $\Delta\varepsilon$ formed from the groups of equations.

The Moon's Semidiameter.

24. From a consideration of the work of J. Peters,[b] L. Struve,[c] and H. Batterman,[d] I have adopted as the best value of the semidiameter

$$s_0 = 932''.58.$$

[a] Monthly Notices, R. A. S. Vol. LXV, p. 564, April, 1905.
[b] Ast. Nach. CXXXVIII, S. 147.
[c] Ast. Nach. CXXXV, S. 175.
[d] Beobachtungs-Ergebnisse der Königlichen Sternwarte zu Berlin, Hefte Nr. 5 und 11.

In the original work the geocentric semidiameter was computed from

$$s=[4.75002] \sin \pi,$$

giving, for the constant of $\sin \pi=3422''.07$, $\log \sin \pi_0=8.21986$;

$$s_0=933''.00.$$

The adopted semidiameter therefore requires the correction

$$\delta s_0=-0''.42.$$

which may be taken as constant.

Hansen uses $s_0=934''.08$, correction $=-1''.50$. At Greenwich since 1900 a correction of $-1''.43$ has been applied to Hansen's value, leaving a subsidiary correction of $-0''.07$.

With Hansen's parallax and $s_0=932''.58$, we have for the geocentric semidiameter

$$s=[4.74982] \sin \pi.$$

But if we increase Hansen's parallax by $0''.40$, a correction given by theory, we have

$$s=[4.74977] \sin \pi.$$

The Parallax.

25. The preceding corrections being geocentric, it is now necessary to consider, in addition to them, those of the moon's parallax. We have at the base of these corrections a system of connected quantities requiring a careful study of their relations in order to determine what form of correction for parallax is best. These are the dimensions of the geoid, its compression, the difference between the astronomical and geometrical latitude of the point of observation, which we may regard as the deviation of the plumb line at the point, the intensity of gravity, and the parallax of the moon, which it is common to refer to the earth's equatorial radius.

Whether, in the present investigation, it will be profitable to attempt the determination of any of these quantities from the occultations can be settled only after the latter are discussed. Whatever the decision on this point, it is sufficient to our present purpose to reduce all the apparent positions of the moon to the best attainable value of the quantities growing out of the parallax of the moon.

Let us first consider local deviations of the plumb line. In astronomical investigations it has always been tacitly assumed that the geographic and the astronomical terrestrial longitudes of the station are identical. This can be the case only when the direction of the plumb line intersects the earth's axis of rotation. Since local deviations in the direction of gravity are as likely to affect the longitude as the latitude, the two effects are equally worthy of study. Using round numbers, the maximum change in the direction of the moon caused by such a deviation is about one-sixtieth of the change in the geocentric position of the observer; in other words, $1'$ of deviation of the plumb line will correspond to a maximum error of less than $1''$ in the position of the moon, and therefore to an average error yet smaller. Since the deviations amount only to a very few seconds, except in mountainous regions, it follows that the error thus produced in the positions of the moon may be neglected, and that we may adhere to the theory of the ellipsoidal figure of the geoid in all discussions of the observations of the moon having an astronomical and not a geodetic purpose.

We must still use the best attainable value of the compression of the geoid, and it will then be a question whether a new determination of the compression can be inferred from the occultations. Professor Battermann in the discussion of the second series of his occultations has taken an

important step in this direction by introducing into his equation two unknown quantities which depend upon the parallax and the compression. Whether it is practicable to utilize the work in this way remains to be seen.

A defect in astronomical practice consists in taking the equatorial radius of the earth as the fundamental length to which the moon's parallax is referred. As a matter of fact, the mean radius, for which we may take indifferently the mean of the three axes, or the radius at mean latitude, where $\sin^2\varphi'=\frac{1}{3}$, should be, in theory at least, adopted as the radius of reference. It is practically this radius which is best determined by geodetic measurements, and for which the intensity of gravity can best be ascertained through observations of the pendulum. Accepting this, we have first to consider the error to which the parallax of the moon referred to this radius is liable when determined from gravitational theory. This method rests on the equation

$$a^3n^2=M+m,$$

M and m being the respective masses of the earth and moon in gravitational units; a the moon's mean distance and n its mean sidereal motion in the unit of time. The value of M is derived from pendulum observations. When the formulæ are reduced to their most concise form we find that the equation which gives π_1, the mean parallax of the moon, in terms of l_1, the length of the seconds pendulum at mean latitude, and ρ_1, the mean radius of the earth, is of the form

$$\pi_1^3=K\frac{\rho_1}{l_1},$$

K being a constant of which the value is known with all necessary precision. We may regard the mean radius of the geoid, as determined from geodetic measures, to be accurate within a few hundred meters, say 0.00005 of its whole amount. This proportional error would imply an error of more than 318 meters in the determination, which seems to be the probable limit. The proportional error of l_1 must, I suppose, be smaller than this. The proportional error in π_1 being only one-third of that in ρ_1 and l_1, the maximum error which we have to fear in this quantity can scarcely be much greater than

$$\pm 0.000025\pi_1=\pm 0''.09.$$

As we can not hope to detect so small an error as this from observations of the moon, we may regard the parallax of the latter, referred to the mean radius of the earth, as a known quantity not subject to correction. It follows that the only quantity which remains so subject will be the compression of the geoid. We have, therefore, to express the parallactic corrections in terms of the compression. Putting

ρ_1, the mean radius of the earth;
α, the compression;

the radius in latitude φ' is, when all powers of α above the first are neglected,

$$\rho=\rho_1[1+\alpha(\tfrac{1}{3}-\sin^2\varphi')]. \tag{23}$$

The author has published computations of the constant of the moon's parallax from gravitational theory first in "Elements and Constants,"[a] and then in the Encyclopædia Britannica, supplement to the ninth edition. It seems desirable to repeat the computation from the most recent data bearing on the result. I am indebted to Professor Helmert for the following numbers expressing the most probable form and dimensions of the geoid from all data at present available. Along with

[a] The Elements of the Four Inner Planets and the Fundamental Constants of Astronomy.

them are given for comparison the numbers of Clarke, Bessel, and Listing:

	a	b	ρ_1	α
Helmert	6377980	6356596	6370843	1+298.26
Clarke	6378249	6356515	6370997	1+293.46
Bessel	6377397	6356079	6370282	1+299.15
Listing	....	....	....	1+288.48
H−C	−269	+ 81	−154	....
H−B	+583	+517	+561	....

The length of the seconds pendulum derived by Helmert[a] is

$$L = 0^{m}.990918\ (1+0.005310 \sin^2 \varphi),$$

from which follows for the force of gravity, affected by centrifugal force,

$$g = 9^{m}.77997\ (1+0.005310 \sin^2 \varphi).$$

The expression for the centrifugal force is

$$\Delta g = 0^{m}.03392\ \rho \cos \varphi' \cos \varphi.$$

At mean latitude ($\sin^2 \varphi' = \frac{1}{3}$) these data give

	m
Apparent gravity.....	9.79743
Centrifugal force......................	0.02253
Actual gravity	9.81996

I adopt from "Elements and Constants," page 193,

Mass of moon: Mass of earth $= 1 : 81.45$,

and from page 194,

Motion of moon in a Julian century, 1336.85 rev.,

giving for motion in arc in one second of time

$$\log n = 4.425159 - 10.$$

Proceeding as in Elements and Constants, section 97, we find that when any radius ρ of the earth is expressed in meters, the corresponding horizontal parallax π of the moon is given by the equation

$$\sin \pi = [1.415232 - 10] \rho.$$

Hence, for the mean radius ρ_1,

$$\log \sin \pi_1 = 8.219429,$$

or expressed in seconds,

$$\sin \pi_1'' = 3418''.65.$$

For the constant of the sine of the equatorial horizontal parallax we then have

$$\sin \pi_0'' = 3418''.65\ (1+\tfrac{1}{3}\alpha). \tag{24}$$

The transformation of Hansen's parallax shows, that in his tables,[b]

$$\sin \pi_0'' = 3422''.07.$$

[a] Höheren Geodäsie, II, p. 241.

[b] Astronomical Papers of the American Ephemeris, Vol. I, Part II.

Using the parallax of Hansen's tables, and a compression α_0, the adopted constant of the sine of the horizontal parallax at latitude φ' will be equivalent to

$$3422''.07\ (1-\alpha_0 \sin^2\varphi'), \tag{25}$$

while the value found above is

$$3418''.65\ [1+\alpha\ (\tfrac{1}{3}-\sin^2\varphi')], \tag{26}$$

α being the true value of the compression, which appears in the equation as an indeterminate quantity. The difference between these last two expressions will be the symbolic correction to the adopted parallax, practically that of Hansen's tables. Putting

$$\delta\alpha=\alpha-\alpha_0,$$

the correction of the adopted compression, the total correction of the local horizontal parallax, or of $\rho \sin \pi_0$ is, with all necessary precision,

$$\varDelta(\rho \sin \pi_0)=-3''.42+1140''\ \alpha + \sin^2\varphi'\ (3''.42\ \alpha_0-3419''\ \delta\alpha). \tag{27}$$

26. Our next step will be to express the corrections to the adopted parallaxes in longitude and latitude. For this purpose approximate expressions for the parallaxes themselves will suffice. Using the notation of §6, put

π, the horizontal parallax for the arbitrary unit-radius;
ρ, the radius of the earth for the place;
π_l, the parallax in longitude;
π_b, the parallax in latitude;

neglecting quantities of the second order as to the latitude and parallax, we shall have

$$\pi_l=\rho \sin \pi \cos \beta \sin (l-\lambda), \tag{28}$$

where β and λ are the coordinates of the observer. Substituting for $\cos \beta \cos \lambda$, and $\cos \beta \sin \lambda$, their values in terms of equatorial coordinates, and τ the sidereal time, namely

$$\left.\begin{aligned} \cos \beta \cos \lambda &= \cos \varphi' \cos \tau, \\ \cos \beta \sin \lambda &= \cos \varphi' \sin \tau \cos \varepsilon+\sin \varphi' \sin \varepsilon, \end{aligned}\right\} \tag{29}$$

to which we add for reference

$$\sin \beta=\sin \varphi' \cos \varepsilon-\cos \varphi' \sin \varepsilon \sin \tau,$$

we shall have

$$\begin{aligned} \pi_l=\rho \cos \varphi' \sin \pi\ [\cos^2 \tfrac{1}{2}\varepsilon \sin (l-\tau)+\sin^2 \tfrac{1}{2}\varepsilon \sin (l+\tau)] \\ -\rho \sin \varphi' \sin \pi \sin \varepsilon \cos l. \end{aligned}$$

The last term of the first line is quite small and is also without systematic effect upon the result; we may therefore omit it. The original expression (28) for π_l is too small by a factor having the average value of 0.01. We may therefore put for our immediate purpose

$$\begin{aligned} \pi_l=+0.97\ \rho \cos \varphi' \sin \pi \sin (l-\tau) \\ -0.40\ \rho \sin \varphi' \sin \pi \cos l. \end{aligned}$$

Putting

r, the geocentric distance of the moon in terms of the unit radius of the earth;

r', the distance of the moon from the observer;

the apparent latitude b' is given by the equation

$$r' \sin b' = r \sin b - r\rho \sin \pi \sin \beta,$$

or, since $r \sin \pi = 1$,

$$r' \sin b' = r \sin b - \rho \sin \beta.$$

Putting $\varDelta r = r' - r$, and $\cos b = 1$, we have

$$b' = b + \pi_b,$$
$$r' = r + \varDelta r,$$

then, neglecting quantities of the second order as to the parallax,

$$\pi_b = b' - b = -\frac{\rho}{r} \sin \beta - \frac{\varDelta r}{r} \sin b.$$

The maximum range of $\sin b$ is between the limits ± 0.09 and, being as often positive as negative, its systematic effect as a factor of $\varDelta r$ will be insensible. We may therefore drop it entirely. Putting as before, $\sin \pi$ for $1:r$, we shall now have

$$\pi_b = -\rho \sin \pi \sin \beta.$$

Putting for $\sin \beta$ its value as already given, and replacing $\sin \varepsilon$ and $\cos \varepsilon$ by their numerical values, gives

$$\pi_b = -0.92\ \rho \sin \varphi' \sin \pi + 0.40\ \rho \cos \varphi' \sin \pi \sin \tau.$$

The compression which I shall use as definitive in the present work is that of Helmert, as privately communicated,

$$a = 1 : 298.2 = 0.003353.$$

This gives, from (24), for the constant of the sine of the equatorial horizontal parallax

$$\sin \pi_0'' = 3422''.47,$$

showing a correction of $+0''.40$ to the Hansenian value. The correction of the actual parallax at any place will depend also on the adopted compression. Taking the earth's equatorial radius as unity we have, approximately,

$$\rho \sin \varphi' = (1-2a) \sin \varphi + a \sin^3 \varphi,$$
$$\rho \cos \varphi' = \cos \varphi\ (1 + a \sin^2 \varphi).$$

It follows that the corrections of these coordinates for the compression are

$$\left.\begin{aligned} \varDelta(\rho \sin \varphi') &= -2\delta a \sin \varphi + \delta a \sin^3 \varphi, \\ \varDelta(\rho \cos \varphi') &= +\delta a \sin^2 \varphi \cos \varphi. \end{aligned}\right\} \qquad (30)$$

Three values of a have been used in the course of the reductions, those of Bessel, Clarke, and Listing:

Bessel	$a_0 = 1 : 299.15 = .003343$	$\therefore\ \delta a = +.000010$
Clarke	$a_0 = 1 : 293.46 = .003408$	$\delta a = -.000055$
Listing	$a_0 = 1 : 288.48 = .003466$	$\delta a = -.000113$

We use the notation

$$h' = \rho \sin \varphi' \sin \pi,$$
$$k' = \rho \cos \varphi' \sin \pi.$$

Disregarding negligible quantities, we have the corrections

$$\Delta h' = \sin \pi \, \Delta(\rho \sin \varphi') + \sin \varphi \, \delta\pi,$$
$$\Delta k' = \sin \pi \, \Delta(\rho \cos \varphi') + \cos \varphi \, \delta\pi.$$

From (30) and $\delta\pi = +0''.40$, we now have

$$\Delta h' = (0''.40 - 2\,\delta\alpha \sin \pi) \sin \varphi + \delta\alpha \sin \pi \sin^3 \varphi,$$
$$\Delta k' = 0''.40 \cos \varphi + \delta\alpha \sin \pi \cos \varphi \sin^2 \varphi.$$

From the three values of $\delta\alpha$ given above we have the following results:

When Bessel's compression has been used:

$$\Delta h' = +0''.33 \sin \varphi + 0''.03 \sin^3 \varphi,$$
$$\Delta k' = +0''.40 \cos \varphi + 0''.03 \cos \varphi \sin^2 \varphi.$$

When Clarke's compression has been used:

$$\Delta h' = +0''.78 \sin \varphi - 0''.19 \sin^3 \varphi,$$
$$\Delta k' = +0''.40 \cos \varphi - 0''.19 \cos \varphi \sin^2 \varphi.$$

When Listing's compression has been used:

$$\Delta h' = +1''.17 \sin \varphi - 0''.39 \sin^3 \varphi,$$
$$\Delta k' = +0''.40 \cos \varphi - 0''.39 \cos \varphi \sin^2 \varphi.$$

In all cases the corrections to the apparent longitude and latitude of the moon are

$$\Delta l' = +0.97\,\delta k' \sin (l - \tau) - 0.40\,\delta h' \cos l,$$
$$\Delta b' = +0.40\,\delta k' \sin \tau - 0.92\,\delta h'.$$

To the equatorial coordinates the corrections are

$$\cos \delta \, \Delta\alpha = -\delta k' \sin (\tau - \alpha),$$
$$\Delta\delta = -\delta h' \cos \delta + \delta k' \sin \delta \cos (\tau - \alpha).$$

Section III.—Recapitulation of Theoretical Corrections to the Geocentric Position of the Moon Given by Hansen's Tables.

Corrections to the Longitude and Latitude.

27. (A) *To the mean longitude.*—These are the secular and long-period corrections expressed in §15 and tabulated on page 30.

(B) *To the true longitude.*—These are expressed in the form

$$\delta l + h \sin g + k \cos g.$$

In the following expressions the constituents π, g', J, M, and V are reckoned from the earth's perihelion of 1800 ($\pi'=99^\circ.5$ for the equinox of 1800, or $100^\circ.2$ for that of 1850). t is expressed in Julian years counting from 1850.0:

Terms of Mean Period.	*Argument.*
$''$	$\circ \quad \circ$
$\delta l=+0.38 \sin (\Omega+73^\circ.6)$	$320.8+19.3415t$[a]
$+0.26 \sin (2\pi-2J)$	$239.8+20.655t$
$+0.26 \sin (2\pi-3J+268^\circ.2)$	$92.4+\ 9.694t$[a]
$+0.18 \sin (J+22^\circ.5)$	$82.2+30.349t$
$+0.05 \sin (2M-g'+329^\circ)$	$295.2+22.812t$
$+0.07 \sin (2\pi+3V-5g')$	$72.6+36.947t$
$-0.45 \sin \pi$	$179.5+40.673t$
$+0.13 \sin (g+2\pi-20V+19g'+13^\circ)$	$147.2+10.340t$[a]
$+0.11 \sin (g-26V+29g'+51^\circ)$	$255.0+\ 2.826t$[a]
$h=-0.65$	
$-1.15 \cos (2\pi-2J)$	$239.8+20.655t$
$+0.44 \cos (2\pi-3J+268^\circ.0)$	$92.6+\ 9.694t$[a]
$-0.65 \cos (2\pi+3V-5g')$	$72.6+36.947t$
$k=+0.13T^2$	
$-1.15 \sin (2\pi-2J)$	$239.8+20.655t$
$+0.44 \sin (2\pi-3J+268^\circ.0)$	$92.6+\ 9.694t$[a]
$-0.65 \sin (2\pi+3V-5g')$	$72.6+36.947t$
$+0.45 \sin (\Omega-11^\circ.3)$	$45.1+19.341t$[a]

Terms of Short Period.

$$
\begin{aligned}
&\qquad {}'' \\
\delta l =& +0.22 \sin L \qquad\qquad [L= V-E = v-g'] \\
& +0.35 \sin (2L-g'+164^\circ.3) \\
& +0.20 \sin (3L-g'+168^\circ.3) \\
& +1.60 \sin D \\
& -0.15 \sin (D+g') \\
& +0.59 \sin (D-g) \\
& +0.10 \sin (D+g) \\
& +0.23 \sin g' \\
& -0.21 \sin 2D \\
& -0.22 \sin (2D-g) \\
& -0.27 \sin (g-3g'+2\pi) \\
& -0.23 \sin (g+2\pi-3g'+J) \\
& +0.19 \sin (2J-g'+342^\circ) \\
& -0.17 \sin (g+2\pi-2V) \\
& +0.17 \sin (g-V+g') \\
& -0.15 \sin (g+V-g') \\
& +0.15 \sin (g+2\pi-V-g') \\
& +0.14 \sin (g+2\pi+2V-4g') \\
& +0.14 \sin (g+g'-J) \\
& -0.16 \sin (g-g'+J) \\
& -0.17 \sin (2g+2\pi-3g'+J) \\
& -0.14 \sin (2g+2\pi-2V).
\end{aligned}
$$

[a] In these terms the supplement of the argument is used in order to make the motion positive. The third term of h thus becomes $-0''.44$ cos Arg.

Exceptional Term (1862–1882).

$$\delta l = +\ 0''.62 \sin(2g - 4g' + 2\omega - 4\omega').$$

(C) *To the latitude.*—This takes the form

$$\delta\beta = +1''.00 + \sin i \cos(v - \Omega)\,\delta l,$$

where v is the moon's true longitude in orbit.

The preceding corrections were computed and tabulated for all the dates of observation with results found in Chapter V. As it is the author's intention to issue improved tables based on the definitive results of the work, it seems unnecessary to publish the preliminary tables.

The corrections to the position of the star, if necessary, are to be found, and need not be considered here.

With the corrected apparent coordinates of the moon and star, we may now compute the value of D for the corrected provisional theory by the formulæ of §§ 8 or 9. But since nearly all the occultations to be used have been reduced in some form, we may generally find a correction to D by the formulæ of § 10.

Corrections to the Right Ascension and Declination.

28. As longitudes and latitudes alone were used up to 1861 in the independent reductions, no corrections to the equatorial coordinates need be considered before that year. But after 1861, and in some earlier cases when published reductions are used, it may be desirable to transform the corrections of the ecliptical system into those of the equatorial system. This requires that we also consider the correction to the obliquity of the ecliptic.

In most of the reductions the R. A. and Decl. of the moon are taken from the British Nautical Almanac. Here the obliquity of Bessel's Tabulæ Regiomontanæ was used from 1835 until 1862, and that of Leverrier from 1863 until 1900. The reduction to that of Newcomb's Tables is found as follows:

Bessel	$\varepsilon = 23°\ 27'\ 31''.95 - 0''.457t$
Leverrier	$\varepsilon = 23°\ 27'\ 31''.83 - 0''.4759t$
Newcomb	$\varepsilon = 23°\ 27'\ 31''.68 - 0''.4684t$

Reduction of Bessel	$\delta\varepsilon = -0''.27 - 0''.0114t$
Reduction of Leverrier	$\delta\varepsilon = -0''.15 + 0''.0075t$

where t is counted in years from 1850. The corrections for decennial epochs are as follows:

Reduction of the Obliquity.

Bessel.		Leverrier.	
Year.	$\Delta\varepsilon$	Year.	$\Delta\varepsilon$
	$''$		$''$
1830	−0.04	1860	−0.08
1840	−0.16	1870	0.00
1850	−0.27	1880	+0.08
1860	−0.38	1890	+0.15
1870	−0.50	1900	+0.23

The corrections of the longitude, latitude, and obliquity may be transformed to those of R. A. and Decl. by well known formulæ. The coefficients of the transformation of δl and δb are tabulated in the author's work of 1876, Investigation of Corrections to Hansen's Tables of the Moon, etc., and also in his Compendium of Spherical Astronomy, Appendix, Table XXI. But instead of computing $\Delta\alpha$ and $\Delta\delta$, he has generally preferred to compute at once the correction to D. In doing this we remark that the small corrections of short period of which we have given the expressions may be applied indifferently to the longitude in orbit or to the ecliptic longitude. But the secular corrections and those of long period are applicable to the longitude in orbit. The correction to the distance of the moon and star may therefore in most cases be most conveniently computed by the equation (13) of §10.

Chapter IV.

DATA RELATING TO STATIONS AND ORIGINAL OBSERVATIONS.

29. The great majority of the observations have been taken from published sources so well known and generally accessible that it does not seem necessary to cite the original times of the occultations in detail. The requisite original data for each occultation are the position of the station and the mean time at which the occultation was observed. There are, however, a few cases in which the positions of the station had to be specially investigated, and other cases in which the mean time had to be computed. In these cases some details of the work may be useful, as may also be some statements respecting the sources and the use made of them.

All the observations before 1750 being fully discussed in the Researches of 1878, the present statement refers only to the period since 1750.

The Greenwich observations during the time of Bradley, Bliss, and Maskeleyn are found in the published volumes, mostly scattered in their proper chronological order among the meridian observations. Generally, the apparent time of the occultation is given, making necessary the application of the equation of time.

The Paris observations for 1801 and a few following years are found in the regular volumes published by Arago.

The richest of all the sources is the Astronomische Nachrichten, most of the volumes of which contain observations of occultations.

Some other sources are: Memoirs and Monthly Notices of the Royal Astronomical Society; The Astronomical Journal; Sternbedeckungen und Mondsterne beobachtet auf der K. K. Sternwarte in Krakau, herausgegeben von Dr. Max. Weisse, director, Krakau, 1855; Bestimmungen des Monddurchmessers aus Neun Plejadenbedeckungen des Zeitraumes 1839 bis 1876, mit gleichzeitiger Ermittlung der Oerter des Mondes. (Inaugral-Dissertation der mathematischen und naturwissenschaftlichen Facultät der Kaiser-Wilhelms-Universität Strassburg zur Erlangung der Doctorwürde vorgelegt von Friedrich Küstner aus Görlitz, Halle, 1880.) Beobachtungs-Ergebnisse der Koniglichen Sternwarte zu Berlin, Hefte 5, 11, und 13, von Dr. H. Battermann, 1891–1910. Observations made at the [temporary] Naval Observatory, Washington, by Lieut. J. M. Gilliss, U. S. Navy, Washington, 1846.

The regular annual volumes of the Greenwich, Cambridge, Washington, and Radcliffe (Oxford) Observatories need only be mentioned.

Remarks on the Stations and Series of Occultations.

30. *Cambridge, 1791–1831.*—The observations of this series were published by Airy in the Memoirs of the Royal Astronomical Society, Volume XXII. They are of much value, owing to their early date. An undue number of them are, however, discordant to an extent that can be accounted for only by errors in the times as published, which probably correspond to the times recorded. The most notable examples of those among the earlier observations are given by the occultation of α Tauri on March 27, 1792, and θ Libræ on April 9, both of which are wrong by several minutes. All the observations of 1812 are discordant by corresponding amounts, though the clock determinations appear good.

The longitude given by Airy for the observatory of St. Johns is $28^s.64$ E., but I actually used $27^s.9$—for what reason I can not now say.

Habana.—A valuable series by Don Ferrer is found in the Memoirs of the Royal Astronomical Society, Volume IV. Don Ferrer gives the latitude of his observatory as $23° \ 8' \ 17''.5$ and states that it is $23''.6$ east of the tower of Morro Castle.

Harkness determined a station

$$\varphi = 23° \quad 8' \quad 3''.0,$$
$$\lambda = \ 0^h \quad 21^m \quad 12^s.54,$$

west of Washington, which was $1' \ 17''.9$ south and $0^s.85$ east of Morro Light;

Hence Morro Light	$\varphi = 23° \ 9' \ 21''$	
	$\lambda = \ 0^h \ 21^m \ 13^s.39$	west of Washington.
	$\lambda = \ 5^h \ 29^m \ 25^s.5$	west of Greenwich.
Red. to Ferrer's station	$-1^s.6$	
Ferrer's station	$\lambda = \ 5^h \ 29^m \ 23^s.9$	
	$\varphi = 23° \ 8' \ 17.''5$	

It is assumed that the tower of Morro Castle = Morro Light.

Dorchester, Mass.—The observations by William C. Bond are found in the Memoirs of the American Academy of Arts and Sciences.

Cracow.—Weisse gives as the position of his observatory

$$\varphi = +50° \ 3' \ 50''.00,$$
$$\lambda = -1^h \ 10^m \ 28^s.41.$$

It may be assumed that this position is the same as that of the modern university observatory, which has been adopted from the ephemerides.

Cape of Good Hope.—The observations, with their complete reduction, are found in the publications of the Cape Observatory. For the reduction of those previous to 1863 the writer supplied the longitudes and latitudes of the moon, as computed from Hansen's tables.

Washington.—There are three principal stations in Washington. The first, the old observatory of Captain Gilliss, at which observations were made during the years 1839–1842, in connection with the Wilkes's exploring expedition. The second is the old Naval Observatory, and the third the new observatory. The observations at the second point began in 1862.

There is also an unpublished series of observations made at a locality known as Wiesner Farm, by two of my assistants, supplied with all the instruments necessary for accurate work, and who were supposed to be quite capable of making good observations. Their probable error is, however, unduly large, and accordingly no use has been made of them.

Leipzig.—There are two stations at which observations were made of which the second is distinguished as Nr. Leipzig.

Strassburg.—Observations were made at both the old and the new university observatories, which are designated in the accompanying list as (1) and (2). They are, however, not distinguished in what follows.

Cobham, England.—The observations made here were communicated by the observer.

Reduction to Geocentric Coordinates.

31. From what has already been remarked (Chapter III, §26), it will be seen that three different values of the compression were used in the earlier reductions, and a fourth, that of Helmert, in the final ones. All the earlier values were reduced to the latter.

The important question whether the actual figure of the geoid is satisfactorily determined from observations of gravity is one as to which the author feels in doubt. It is to be hoped that the recent extended measures of arcs, both of the parallel and of the meridian, will result in settling this question. It is only necessary here to remark that all the older reductions for parallax were reduced to Helmert's compression and to the writer's determination of the constant, as given in Chapter III.

The adopted mean times of the phases observed are, before 1847, generally the same as those for which the positions of the moon are computed, as found in the next chapter.

List of Geographical Positions.

32. The adopted longitudes from Greenwich, the geographic latitudes, and the geocentric coordinates as computed with Helmert's compression are shown in the following table.

The years of observation in the last column are only approximate summary statements, intended to give a general idea of the series used.

Stations and Series of Occultations.

Station.	West Longitude.	Latitude.	$\rho \sin \varphi'$.	$\rho \cos \varphi'$.	Period.
	h m s	° ′			
Paris	−0 9 21.0	+48 50.2	9.87461	9.81919	1810–1829
Greenwich	0 0 0.0	+51 28.6	9.89138	9.79526	1753–1814; 1827–1831; 1847–1908
Cambridge, England	−0 0 27.9	+52 12.9	9.89579	9.78816	1791–1831; 1847–1860
Habana	+5 29 23.9	+23 8.3	9.59165	9.96380	1808–1812
Dorpat	−1 46 53.5	+58 22.8	9.92835	9.72062	1812–1826
Dorchester	+4 44 16.2	+42 19.0	9.82590	9.86956	1825–1839
Berlin	−0 53 34.8	+52 30.3	9.89750	9.78532	1826–1846; 1876–1903
Cracow	−1 19 50.3	+50 3.9	9.88261	9.80834	1825–1854
Cape of Good Hope	−1 13 55.0	−33 56.1	9.74436n	9.91936	1834–1907
Washington (1)	+5 8 2.1	+38 53.5	9.79551	9.89174	1839–1842
Washington (2)	+5 8 12.1	+38 53.6	9.79553	9.89173	1862–1884
Washington (3)	+5 8 15.8	+38 55.2	9.79578	9.89157	1906–1908
Cambridge, U. S. (1)	+4 44 27.9	+42 22.2	9.82635	9.86919	1840–1844
Cambridge, U. S. (2)	+4 44 31.0	+42 22.8	9.82643	9.86913	1845–1850
Leiden	−0 17 56.2	+52 9.3	9.89544	9.78874	1857–1872
Radcliffe	+0 5 2.6	+51 45.6	9.89309	9.79256	1862–1876
Göttingen	−0 39 46.3	+51 31.8	9.89171	9.79476	1868–1877; 1887–1895
Kremsmünster	−0 56 31.6	+48 3.4	9.86938	9.82587	1869
Madrid	+0 14 45.1	+40 24.5	9.80947	9.88229	1869
Altona	−0 39 46.2	+53 32.8	9.90347	9.77486	1871
Neuchatel	−0 27 49.9	+47 0.0	9.86201	9.83454	1872
Leipzig	−0 49 34.0	+51 20.1	9.89052	9.79660	1869–1876
Nr. Leipzig	−0 49 29.6	+51 21.8	9.89069	9.79634	1876–1880
Nikolaieff	−2 7 53.8	+46 58.4	9.86180	9.83478	1873–1883
Kiel	−0 40 35.8	+54 20.5	9.90787	9.76660	1876
Strassburg (1)	−0 31 2.5	+48 34.9	9.87290	9.82138	1873–1880
Strassburg (2)	−0 31 4.7	+48 35.0	9.87291	9.82137	1881–1898
Vienna	−1 5 31.7	+48 12.6	9.87039	9.82454	1869–1879
Hamburg	−0 39 53.8	+53 33.1	9.90349	9.77480	1882–1896
Prague	−0 57 40.3	+50 5.3	9.88275	9.80813	1883–1898
Pola	−0 55 23.1	+44 51.8	9.84625	9.85124	1886–1901
Kasan	−3 16 29.0	+55 47.4	9.91558	9.75091	1890–1907
Engelhardt	−3 15 16.5	+55 50.3	9.91583	9.75037	1904–1907
Padua	−0 47 29.2	+45 24.1	9.85033	9.84716	1891–1896
Santiago	+4 42 46.2	−33 26.7	9.73878n	9.92182	1892–1897
Evanston	+5 50 42.3	+42 3.6	9.82375	9.87132	1897–1901
Wilhelmshaven	−0 32 35.2	+53 31.8	9.90338	9.77501	1898–1904
Cobham	+0 1 2.6	+51 19.7	9.89048	9.79667	1902–1904
Utrecht	−0 20 31.0	+52 5.2	9.89503	9.78941	1904–1905
Tokio	−9 18 58.0	+35 39.3	9.76317	9.91034	1905–1906
Jena	−0 46 21.9	+50 56.3	9.88808	9.80033	1905
Königsberg	−1 21 59.0	+54 42.8	9.90989	9.76264	1905–1907

Chapter V.

POSITIONS OF THE MOON FROM HANSEN'S TABLES, WITH REDUCTION OF THE LONGITUDES TO THE PROVISIONAL THEORY.

33. The foundation for the whole theory consists in positions of the moon computed from Hansen's tables. The only substantial modification made is in the omission of the nutation. As the effect of this is eliminated in comparing the position of the moon and of the occulted star, the geocentric quantities will remain unchanged if the nutation is omitted from both bodies. In theory the correction for parallax will be slightly altered, but the alteration is too minute to make it worth while to apply a nutation which is substantially eliminated from the final result. Withal it would be necessary, if nutation were retained, to correct that of Hansen for reduction to the value used in the ephemeris of the star. By completely ignoring it these complications are avoided.

When a long series of positions are to be computed the work may be abridged by various devices described in the Researches of 1878, pages 189–195. These are the following:

(A) *Formation of the arguments of single entry.*—Since the arguments are expressed in days, and, small secular terms aside, increase uniformly with the time, all arguments for one epoch may be derived from those for a preceding epoch by the addition of the interval, periods being subtracted when necessary. An indefinite series of arguments may be thus formed, but it is advisable not to jump over long intervals in the series. The correctness of the arguments may be proved by computing the values for the two extreme epochs from the tables and comparing those for the end of the series with the values derived by continuous addition.

(B) *Double-entry arguments.*—As these remain constant throughout each separate period of the fundamental argument g, it is only necessary to form a series of arguments, and add or subtract constants dependent on the intervening periods of g. The device adopted for this process is described in the former work.

(C) *Terms of long period.*—It is of course much easier to compute the values of these terms for intervals of 10 years, or for the beginning of each year, and then interpolate them, than it is to compute each separately. The following table, giving the tabular quantities of long period, is a continuation of that terminating on page 194 of the Researches of 1878.

Here Δg is the sum of Hansen's Venus-terms of long period, as derived from Tables XLI and XLII, arguments 30 and 31, without modification.

The next two columns give the corresponding corrections of arguments 32 and 33.

The last three columns contain data for the correction on account of secular acceleration, as explained on page 191 of the Researches of 1878.

Continuation of Table in Researches of 1878, pages 192–194.

Year.	Δg	$\Delta 32$	$\Delta 33$	$\frac{d\Delta g}{dt}$	$\frac{d\Delta 32}{dt}$	$\frac{d\Delta 33}{dt}$
1830	4561	727	675	−20.8	−5.4	−3.6
1831	4421	711	660	−19.7	−5.4	−3.5
1832	4283	694	645	−18.9	−5.4	−3.4
1833	4146	679	631	−17.5	−5.4	−3.4
1834	4012	663	616	−16.4	−5.3	−3.3
1835	3879	648	602	−15.1	−5.3	−3.2
1836	3749	633	588	−14.0	−5.3	−3.1
1837	3621	618	574	−12.6	−5.2	−3.0
1838	3496	603	560	−11.5	−5.2	−3.0
1839	3373	589	547	−10.4	−5.1	−2.9
1840	3252	575	534	− 9.1	−5.0	−2.8
1841	3134	562	522	− 7.7	−4.9	−2.7
1842	3019	548	509	− 6.3	−4.9	−2.6
1843	2907	535	497	− 4.7	−4.8	−2.5
1844	2798	523	486	− 3.3	−4.8	−2.4
1845	2692	510	474	− 2.2	−4.8	−2.3
1846	2588	498	463	− 0.6	−4.7	−2.2
1847	2488	488	453	+ 0.6	−4.7	−2.1
1848	2390	476	442	+ 2.5	−4.6	−2.0
1849	2297	465	432	+ 3.6	−4.5	−1.9
1850	2206	454	422	+ 5.2	−4.4	−1.8
1851	2119	445	413	+ 6.8	−4.3	−1.7
1852	2036	435	404	+ 8.2	−4.2	−1.6
1853	1956	425	395	+ 9.9	−4.2	−1.4
1854	1879	417	387	+11.5	−4.1	−1.3
1855	1806	408	379	+13.2	−3.9	−1.2
1856	1737	400	372	+14.5	−3.8	−1.1
1857	1671	393	365	+16.2	−3.7	−1.0
1858	1609	385	358	+17.8	−3.7	−0.8
1859	1551	379	352	+19.5	−3.6	−0.7
1860	1497	372	346	....	...	...
1870	1175	...	...	....	...	...
1880	1270	...	...	....	...	...

Explanation of Modifications in the Use of Hansen's Tables.

Args. 1–27: No change.

g: Venus-terms (Args. 30–31) are included in *g*.

32–33: The corrections for Venus-terms and the constants of args. 28–29, are alone included in the corrections of args. 32–33. The omitted correction is principally

$$\left\{ \begin{matrix} +190 \\ +177 \end{matrix} \sin (\theta + 184^\circ.7 \right\}.$$

The maximum effect of each omission is about $\pm 0''.16$.

Args. 34–50: From Hansen unchanged except omission of 47 and 49.

Args. 47 and 49: Found near middle of fourth column opposite arg. *g*.

Constant is a misnomer here; it is the sum of the numbers in the right-hand column namely:

1. The tables for args. 47 and 49.
2. The interpolation products for the other tables.

$\left.\begin{matrix}\text{Table VII, Arg. 28, const. } 500 \\ \text{Table IX, Arg. 51, const. } 50\end{matrix}\right\}$ Nutation terms: omitted in first computation.

34. *Example of computation.*—The computation of the tabular positions was made in ruled computing books, the form being that shown in the example appended. As there is no complete check on this part of the work, it was all done in duplicate.

At the top of the page is the number of the date. These numbers do not form a continuous series, because additional sets of observations were added from time to time. In order to reduce the skilled computations necessary to a minimum, the system was adopted of copying the values of the arguments from the original books of arguments into the pages. The second column gives therefore the value of the argument as computed.

To reduce the labor still more to a matter of routine computing and copying, the tabular numbers before interpolation are, in the case of the single-entry arguments, copied from the printed tables, as are also the differences taken from the tables. The product of each difference by the excess of the actual over the tabular argument follows in the next column.

The sums of the non-interpolated numbers plus the sums of these products form the interpolated sum of the terms.

The sum of the differences multiplied by appropriate factors as necessary serves to compute the variation in 0.01 of a day.

The remainder of the computation will be easily made out by anyone familiar with the use of the tables. Each final value of the coordinates is given in duplicate, one result being that of the best of the original computations, the other of the duplicate computations. For example, in date 57 one result for the longitude, that of which the computation is copied was 24° 18′ 44″.71. The result of the duplicate computation was the same in this particular case. In the same way one sum of the variation of the longitude was 7′ 6″.60 and the other was 7′ 6″.71.

It seems unnecessary to repeat the details for the computation of latitude. Anyone mastering the methods of using Hansen's tables will be able to follow the computation.

LONGITUDE AND PARALLAX OF THE MOON, FROM HANSEN'S TABLES.

DATE 57: [1843, Sept. 11].

g		1.25	1.50				
Arg. 1		2.15	2.14				
2		1.91	1.95				
10		0.32	0.32				
×t	43.69	4.38	4.41				
Arg. 1	52.72	2494	2393		Arg. 1	3.701	3.773
2	44.31	1615	1775		2	200	199
3	77.14	3024	2857		3	234	234
4	50.05	3117	3150		4	159	165
5	127.17	1737	1749		5	1.361	1.374
6	71.79	1876	1884		6	102	101
7	78.30	600	538		7	286	323
8	16.07	242	240		8	14	14
9	59.38	565	578		10	577	568
10	10.87	358	390		12	758	804
11	34.88	382	357		14	67	71
12	36.78	146	184		15	149	141
13	11.54	247	242		16	19	19
14	45.20	374	338	′ ″	17	16	16
15	31.62	184	187	7.698			
16	11.07	492	490	21.528	32	7.643	7.802
17	1.36	298	300	36.786	33	+.159	
18	38.57	22	22	3.969	37		
19	2.78	92	95	0.018	38		
20	23.76	246	255	52 0.815	42		
21	26.95	246	243	45.89	z		
22	1.91	114	114				
23	16.75	172	172	′ ″			
24	13.37	125	132	53 56.71	Sum		
25	2.87	161	164	4.83	Table XXI		
26	6.17	46	46	54 1.54	Parallax		
27	7.63	42	42				
		192	193				
		19209	19130				
		−79					

g		1.3358840	31.05	22
		19182	483.5	111
28*	5234.5	10		
29	4516	140	− 3	−177
32	20.052049	78103	−737	−151
33	18.060313	917013	+728	+ 22
34	88.5239	270467	+ 8.6	+ 21
35	182.279	1253	+ 1.5	+ 11
36	140.845	12723	+ 6.0	+ 27
37	23.0271	46273	+ 76	+ 53
38	10.4072	33801	−134	− 96
39	16.8657	1669	+ 18	+ 11
40	25.1547	3906	− 26	− 13
41	0.0690	829	− 12	− 11
42	5.0555	794	− 28	− 15
43	6.1712	2351	+ 35	+ 4
44	4.6028	1930	+ 9	+ 2
45	1.6456	8116	− 16	− 9
46	1.785	7629	− 2	− 1
48	577.0	180		
50	234.1	223	+882	+283
	Constant	−190	−958	−473
		1.4765242	0.99924	

f_0	180.78865	9.99967		+40	X 0.04387+.68
Δf	7648	4.06901			2.59429
ω	295.20773	9.81452	lgΔz		2.63816
f	180.86513	4.06868	lg f′		
π	203.22427	3.88353	lgΔf		
f+ω	116.07286	164	ω′		
f+π	24.08940	11713	f′		
red. ecl.	21275	111	π′		
	42	11877	f′+ω′		
X × lat. ineq.	435	11824	f′+π′		
Constant	550	25	(red. ecl.)′		
		1	X′		
	24.31242				
		11850			
	° ′ ″	′ ″			
	24 18 44.71	7 6.60	λ′		
	71	71			

LATITUDE OF THE MOON, FROM HANSEN'S TABLES.

DATE 57.

g	1.3359	1.25	1.50	
1	42.66	10.23	10.12	
2	70.36	15.87	16.35	
3	51.08	10.52	10.94	
4	59.49	16.77	16.58	
5	54.36	3.69	3.60	
6	26.51	3.61	3.55	
7	26.81	1.90	1.79	
8	9.74	.80	.80	
9	30.72	2.17	2.15	
10	13.04	.07	.08	
11	7.80	.25	.25	
12	5.22	.92	.90	
13	3.46	1.13	1.12	
14	1.71	.69	.67	
15	19.53	.67	.69	
16	18.94	.39	.39	
17	20.7	.25	.25	
18	9.5	.22	.22	
Σ		70.15	70.45	
Diff.			+30	
Σ			70.24	+ 1
19	17.64454		2 15.63	+ 68
20	182.79953		10.75	− 1
21	8.9389		52.72	− 9
22	12.208		2.11	− 2
23	10.750		42.78	+ 4
24	21.149		26.40	+ 6
25	29.255		42.92	+ 2
26	208.2		2.11	
27	19.9		0.53	
28	17.3		0.05	
f+π	24.09		6.67	− 1
Sum			6 32.91	+ 68
f+ω	116.07287	+4	24 0.68	−16.84
p. p.			− 10.33	− 5
Sin.		+4	30 23.26	
Red.			16.78	
		°	′ ″	
Lat.		+4	30 40.04	
			.07	

(a) f′+ω′	.11877	log.	0.0747
(b) $\Delta\beta_0$	−14.18	log.	−1.1517
(c) Δ (f+ω)		log.	9.8625
(a)×(b)			−1.2264
(b)×(c)			−1.0142

	″
Mot. in $0^d.01$	−16.21
	15

Geocentric Positions of the Moon.

35. The following table contains the geocentric positions of the moon, computed from Hansen's tables for the dates of the occultations between 1753 and 1858. The last column contains the reduction of Hansen's longitude to the provisional theory. Its value is generally omitted in the case of rejected occultations.

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1753, Apr. 19	15 57 58.1	.6652558	239 40 49.0	7 44.29	+2 7 42.1	+39.23	56 28.7	−0.5
Aug. 5	9 34 35.3	.3990197	221 52 34.2	7 51.65	+1 1 0.4	+40.79	57 9.6	+1.0
Oct. 5	8 10 4.5	.3403299	300 40 22.5	7 9.32	+5 15 29.6	− 2.55	54 18.6	+2.5
5	9 30 22.6	.3960950	301 20 16.6	7 9.14	+5 15 14.3	− 2.96	54 17.8	+2.5
1754, Apr. 2	11 55 11.5	.4976610	132 46 46.6	8 39.85	−4 47 45.8	+20.32	59 44.9	+1.2
Nov. 21	8 0 24.5	.3336170	330 53 39.4	7 14.63	+3 3 4.6	−31.43	54 49.6	+1.8
1755, July 5	16 26 42.0	.6852084	65 39 10.1	7 18.34	−4 48 51.0	−11.47	54 44.7	...
18	8 54 20.9	.3710753	236 11 34.3	8 35.83	+4 35 41.4	+19.80	59 28.7	+0.2
1756, Dec. 12	16 9 53.9	.6735406	152 28 23.8	7 20.39	+0 42 22.7	+38.89	55 13.6	...
12	17 30 45.6	.7296945	153 9 38.5	7 20.86	+0 46 1.0	+38.89	55 15.6	...
1757, Feb. 25	6 38 47.0	.2769329	66 22 51.2	7 15.73	−5 7 32.0	+ 9.58	54 45.5	+1.3
25	7 48 55.1	.3256378	66 58 12.6	7 15.35	−5 6 44.2	+ 9.97	54 44.2	+1.3
Apr. 3	10 21 45.9	.4317814	186 8 14.3	7 56.39	+3 36 4.3	+30.05	57 4.0	−1.3
3	11 18 48.5	.4713948	186 39 42.3	7 56.84	+3 38 2.9	+29.80	57 5.5	−1.3
July 30	11 8 21.3	.4641356	307 31 45.5	9 7.06	+0 32 56.8	−50.40	61 21.6	−1.2
1758, Feb. 17	10 31 33.6	.4385835	93 29 54.7	7 14.68	−2 41 34.6	+34.30	54 45.2	+0.5
1761, Dec. 10	9 38 37.0	.4018171	64 35 27.0	8 46.18	+1 14 32.4	+46.67	60 8.9	−0.6
1764, Feb. 20	13 36 51.6	.5672638	199 43 22.0	8 44.32	−1 18 1.6	−46.31	60 7.7	−2.4
20	14 44 44.5	.6144038	200 24 33.4	8 44.12	−1 21 39.6	−46.16	60 7.1	−2.4
1765, Feb. 4	8 55 57.6	.3721944	123 32 46.5	7 35.90	+3 34 1.2	−30.02	55 49.3	−0.1
4	10 15 11.5	.4272164	124 14 35.9	7 36.33	+3 31 14.7	−30.40	55 51.1	−0.1
Sept. 25	5 54 47.9	.2463877	319 49 38.7	8 22.10	−1 34 38.5	+43.82	58 47.4	+0.8
Oct. 2	12 55 56.9	.5388530	55 55 37.5	7 21.78	+5 5 31.7	+ 7.59	54 58.9	−3.8
2	13 26 1.0	.5597338	56 10 59.8	7 21.58	+5 5 47.4	+ 7.39	54 58.3	−3.8
1766, Sept. 22	10 23 11.0	.4327662	55 37 12.5	7 52.44	+5 7 36.7	− 5.38	56 55.6	−4.2
22	10 39 45.3	.4442743	55 46 16.2	7 52.34	+5 7 30.4	− 5.54	56 55.0	−4.2
1767, Sept. 12	15 17 3.0	.6368403	56 28 43.5	8 19.05	+4 34 29.1	−20.07	58 35.6	−5.4
12	16 29 15.1	.6869804	57 10 23.9	8 18.19	+4 32 46.8	−20.55	58 32.7	−5.4
1768, Jan. 27	11 40 17.3	.4863114	56 54 33.1	8 12.90	+4 17 58.1	−26.12	58 13.3	−1.4
27	12 41 53.1	.5290869	57 29 40.8	8 12.50	+4 16 5.3	−26.47	58 12.0	−1.4
1769, Sept. 15	8 1 42.6	.3345209	351 49 52.2	8 17.79	+5 0 10.1	− 2.08	58 13.6	0.0
20	10 21 51.2	.4318426	64 13 58.8	8 32.89	+1 14 12.0	−43.92	59 30.7	−4.0
20	11 16 54.6	.4700764	64 46 39.7	8 32.82	+1 11 24.0	−44.01	59 30.4	−4.0
25	17 24 13.7	.7251586	138 4 50.5	8 9.56	−4 21 36.2	−23.06	57 54.5	−5.4
Nov. 18	15 4 49.5	.6283508	130 7 19.2	8 22.96	−4 20 7.9	−26.31	58 51.4	−5.5
1770, Apr. 7	11 30 50.7	.4797535	170 47 52.0	8 10.32	−4 58 4.1	+10.52	57 50.0	−2.0
28	9 48 41.6	.4084148	81 57 33.6	8 43.34	−1 27 23.1	−46.06	60 2.5	0.0
July 19	14 37 14.5	.6091956	81 16 35.9	8 53.48	−1 29 0.9	−45.74	60 37.8	−2.0
1771, July 4	12 24 8.6	.5167662	10 28 56.7	7 17.53	+2 55 58.3	−31.93	54 59.9	+0.4
4	13 21 41.2	.5567268	10 58 5.7	7 17.78	+2 53 50.1	−32.14	55 1.2	+0.4
Sept. 18	11 56 20.4	.4974583	301 17 40.2	7 10.89	+5 6 0.7	+ 5.17	54 20.8	−0.2
Dec. 24	9 53 28.7	.4121377	132 29 41.3	8 40.67	−5 3 25.7	+ 4.81	59 39.0	−3.5
1772, May 15	11 52 23.0	.4947106	221 28 35.5	8 46.77	+1 9 37.6	+47.06	60 10.3	−2.4
15	13 4 29.6	.5447869	222 12 33.0	8 46.52	+1 13 32.9	+46.88	60 9.4	−2.4
Aug. 17	11 55 11.4	.4966596	16 44 40.0	7 4.12	+0 23 45.9	−37.92	54 6.3	−0.9
Sept. 7	13 6 25.5	.5461284	301 20 38.1	7 33.92	+5 5 52.5	− 7.77	55 43.2	−0.8
1773, Feb. 6	6 51 36.8	.2858425	129 28 42.0	8 18.03	−4 31 35.8	+20.38	58 17.7	−0.6
Sept. 7	20 45 29.2	.8649212	67 0 36.5	7 7.63	−4 47 45.5	−16.30	54 15.7	−2.1
Nov. 1	8 57 15.6	.3730972	65 59 35.3	7 6.49	−4 40 44.3	−16.13	53 57.7	−1.0
1774, Nov. 18	16 19 55.9	.6805081	67 28 17.8	7 19.90	−5 0 0.2	− 1.48	54 43.0	−0.4
1775, Aug. 1	8 54 17.5	.3710358	187 29 52.5	7 19.94	+3 35 29.4	+29.71	55 2.3	−1.3
Dec. 12	9 59 36.4	.4163934	146 10 23.5	7 4.35	+0 48 46.3	+37.61	54 11.4	−2.7
1776, Jan. 29	12 18 58.2	.5131735	67 2 58.1	7 40.85	−4 55 55.9	+15.45	56 15.0	−0.3
Mar. 30	13 58 13.2	.5820971	146 47 16.8	7 3.85	+1 7 0.3	+36.99	54 3.0	−0.8
Apr. 6	14 4 32.1	.5864825	231 37 49.1	7 35.58	+4 59 58.5	− 5.80	55 45.9	−4.2
1777, Oct. 21	8 0 0.0	.3333333	99 22 58.9	8 18.36	−0 12 45.0	+44.07	58 44.5	−2.4
Nov. 15	18 15 39.7	.7608762	70 34 9.3	9 3.69	−2 30 0.4	+42.72	61 7.2	−0.7
16	11 2 1.0	.4597339	81 2 55.0	8 55.50	−1 38 16.6	+45.73	60 43.2	−1.3
16	12 8 26.6	.5058635	81 44 4.1	8 54.96	−1 34 45.4	+45.88	60 41.2	−1.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1778, Feb. 7	11 24 34.2	.4753958	92 23 40.2	8 28.00	−0 31 28.1	+45.75	59 10.3	+2.6
June 24	3 20 0.0	.1388889	92 52 54.7	9 1.46	+0 18 3.9	+50.07	61 2.2	+0.6
24	5 44 0.0	.2388889	94 23 7.1	9 0.94	+0 26 24.0	+49.92	61 0.6	+0.6
Dec. 31	6 3 11.8	.2522200	72 59 50.5	9 0.74	−0 41 29.9	+49.43	61 2.3	+1.5
1779, Feb. 27	12 32 5.9	.5222906	124 26 42.8	8 46.30	+3 42 46.6	+30.97	60 3.9	+2.5
27	14 32 46.6	.6060950	125 40 14.0	8 46.34	+3 47 3.7	+30.24	60 3.7	+2.5
Oct. 30	10 3 10.4	.4188705	110 5 37.1	8 30.12	+3 52 40.4	+31.34	59 15.1	−1.5
Dec. 22	7 18 42.8	.3046621	83 42 22.3	8 50.36	+1 55 33.0	+44.93	60 21.2	−0.4
1781, Mar. 13	15 0 0.0	.6250000	227 34 53.6	8 34.82	−1 7 3.2	−45.54	59 38.5	−2.0
Oct. 16	20 0 0.0	.8333333	203 46 38.3	9 8.19	+0 9 25.5	−50.79	61 25.2	−0.4
1783, Feb. 9	6 0 0.0	.2500000	56 38 18.1	7 8.73	+4 24 9.1	+20.35	54 22.2	−0.8
9	6 36 0.0	.2750000	56 56 10.0	7 8.69	+4 24 59.9	+20.20	54 21.8	−0.8
May 16	11 17 28.2	.4704653	239 17 39.2	9 1.93	−4 31 30.4	−21.42	60 51.5	−0.8
Oct. 7	14 24 56.3	.6006517	344 44 58.0	8 19.14	−0 21 6.8	+45.61	58 35.3	−0.9
Dec. 6	16 14 11.3	.6765198	56 53 25.4	7 26.18	+4 45 59.1	+11.42	55 8.4	−1.8
6	16 50 16.8	.7015835	57 12 3.6	7 25.98	+4 46 27.7	+11.22	55 7.8	−1.8
30	8 6 9.4	.3376089	11 28 3.2	7 55.09	+2 31 59.1	+36.57	57 19.7	−1.3
30	9 11 12.5	.3827837	12 3 48.8	7 54.51	+2 34 43.9	+36.30	57 17.5	−1.3
1784, July 2	12 29 59.3	.5208254	281 45 51.8	8 59.32	−3 54 30.9	+31.07	60 45.6	−2.1
1785, Apr. 11	8 40 0.0	.3611111	57 1 35.8	8 30.29	+5 1 2.1	− 6.32	59 4.6	−2.6
11	9 16 0.0	.3861111	57 22 51.1	8 29.90	+5 0 45.9	− 6.55	59 3.5	−2.6
June 22	11 56 59.2	.4979076	276 54 12.1	8 15.25	−3 1 8.6	+36.18	58 13.9	−1.7
Aug. 16	8 2 16.6	.3349145	277 22 50.9	8 12.34	−3 0 40.4	+37.23	58 13.7	+0.1
1786, Mar. 5	6 40 0.0	.2777777	56 36 57.8	8 32.14	+4 41 11.2	−19.08	59 20.0	−1.0
5	7 16 0.0	.3027778	56 58 18.1	8 31.85	+4 40 22.8	−19.35	59 19.0	−1.0
Nov. 12	17 20 2.0	.7222454	145 44 57.2	7 42.32	−3 16 13.9	−31.67	56 31.5	−4.9
12	18 36 7.3	.7750845	146 25 38.5	7 41.66	−3 19 1.1	−31.35	56 29.0	−4.9
Dec. 9	10 50 13.3	.4515428	137 44 1.3	8 6.09	−2 52 27.1	−37.16	57 55.9	−4.1
9	10 26 39.3	.4768437	138 4 30.8	8 5.70	−2 54 1.0	−37.02	57 54.4	−4.1
1787, Nov. 26	11 10 40.0	.4657407	89 49 32.8	9 1.06	−0 20 10.5	−49.76	61 2.5	−4.4
26	12 19 33.9	.5135867	90 32 40.9	9 0.85	−0 24 8.4	−49.70	61 1.8	−4.4
26	15 26 26.5	.6433621	92 29 35.2	9 0.13	−0 34 52.0	−49.47	60 59.8	−4.4
26	15 41 40.1	.6359361	92 39 6.4	9 0.09	−0 35 44.3	−49.47	60 59.7	−4.4
1788, May 11	9 25 14.7	.3925310	130 44 1.2	8 31.43	−4 13 17.8	−27.70	59 19.2	−1.5
Oct. 18	10 33 37.6	.4400183	73 7 34.0	8 13.64	−0 25 25.5	−44.54	58 19.3	−3.3
18	11 30 12.0	.4793053	73 39 53.5	8 13.83	−0 28 20.4	−44.50	58 20.1	−3.3
Nov. 15	7 23 13.7	.3077975	81 8 7.2	8 29.80	−1 13 7.9	−45.75	59 11.6	−3.4
15	7 50 46.5	.3269272	81 24 22.3	8 29.85	−1 14 35.5	−45.73	59 12.0	−3.4
1789, Nov. 9	12 7 20.8	.5051020	132 37 28.6	8 20.75	−5 15 22.1	− 5.37	58 37.6	−3.1
1790, Mar. 5	17 28 52.6	.7283868	234 34 51.2	8 24.27	+1 8 47.3	+43.99	59 4.1	−4.4
Aug. 17	8 11 52.3	.3415778	241 40 43.9	8 19.17	+2 22 52.1	+39.08	58 43.3	−0.6
Oct. 15	5 34 56.7	.2326009	300 59 37.4	7 47.19	+5 17 42.2	+ 0.15	56 40.0	−0.5
Nov. 17	12 51 54.8	.5360512	15 4 4.6	7 4.76	+1 26 57.6	−37.56	54 4.9	+1.4
1791, Mar. 16	12 15 11.3	.5105477	133 13 22.5	8 4.63	−4 53 16.4	+15.86	57 36.2	+0.5
Apr. 3	0 0 0.0	.0000000	13 19 5.7	7 15.28	+0 47 11.0	−39.83	54 38.0	...
7	6 54 25.4	.2877943	64 16 51.6	7 5.23	−3 34 44.7	−28.94	54 3.6	+2.0
7	7 34 8.9	.3153811	64 36 24.8	7 5.28	−3 36 4.5	−28.79	54 3.8	+2.0
June 12	9 43 45.6	.4053892	213 42 22.8	8 47.04	+1 12 32.1	+45.56	60 18.2	−0.7
Dec. 15	16 24 3.3	.6833718	146 1 31.2	7 26.52	−3 27 37.6	+28.50	55 27.9	−1.9
1792, Mar. 27	8 42 22.5	.3630151	67 22 17.5	7 13.35	−4 44 51.6	−17.46	54 33.2	+1.8
Apr. 9	11 23 26.3	.4746100	236 6 46.1	8 40.30	+4 10 59.2	+28.76	59 41.5	−5.2
9	12 28 54.3	.5200730	236 46 11.9	8 40.44	+4 13 9.4	+28.36	59 41.9	−5.2
1793, Apr. 19	11 28 30.1	.4781263	138 54 55.7	7 5.79	−2 12 17.0	+34.78	54 15.7	+0.8
1794, Mar. 5	7 1 21.2	.2926067	39 27 24.4	8 35.74	−5 1 59.0	−13.90	59 29.4	−0.3
7	6 46 30.0	.2822919	67 4 18.9	8 3.42	−5 10 57.0	+ 7.98	57 39.2	+0.5
Aug. 4	9 33 22.0	.3981715	232 13 2.9	7 24.02	+5 16 21.3	− 3.14	55 14.7	−1.2
Nov. 8	7 11 43.1	.2998046	66 9 42.7	8 50.77	−4 35 32.0	+18.43	60 14.3	−1.1
8	8 3 44.9	.3359366	66 41 39.4	8 50.19	−4 34 24.7	+18.76	60 12.8	−1.1
Dec. 18	18 29 56.9	.7707977	231 55 13.4	7 19.11	+5 1 19.6	− 3.55	54 45.8	−2.4
1795, May 4	12 41 4.1	.5285199	234 28 31.2	7 9.07	+4 38 32.5	−13.93	54 4.4	−2.5
July 25	9 9 48.9	.3818162	234 19 42.0	7 8.96	+4 47 15.3	−16.58	54 18.4	−1.6
Aug. 6	12 30 11.9	.5209710	34 13 44.9	8 32.20	−5 14 32.5	+ 4.13	59 16.1	−4.2
28	11 50 27.2	.4933703	319 4 42.6	8 8.78	−1 47 25.9	−41.52	57 55.5	−2.8
Sept. 28	7 24 10.3	.3084525	7 25 0.6	8 53.00	−4 45 3.8	−15.42	60 18.8	−3.0
Oct. 6	12 39 40.2	.5275485	125 19 29.4	7 54.82	+0 48 36.2	+41.35	57 18.1	−2.4
Nov. 24	7 15 41.2	.3025601	38 37 19.6	9 6.18	−4 53 17.5	+14.57	61 6.8	−0.4
1796, Mar. 14	7 10 47.3	.2991585	64 15 29.6	8 32.98	−3 28 14.4	+33.02	59 25.8	+1.4
14	7 49 15.2	.3258703	64 38 19.8	8 32.87	−3 26 45.8	+33.22	59 25.6	+1.4
Aug. 20	11 31 22.0	.4801157	356 21 31.7	7 52.95	−4 58 48.9	− 9.70	56 47.8	−3.4
1797, Mar. 17	12 52 22.4	.5363703	241 23 44.5	7 28.04	+2 10 39.0	−35.59	55 38.0	−2.0

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0.^d01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1797, Dec. 25	4 31 20.6	.1884328	356 3 45.4	7 12.45	−5 7 8.9	+ 8.65	54 32.8	−0.3
1798, Aug. 8	13 36 46.1	.5672002	96 46 9.8	8 24.92	+2 56 5.3	+36.01	58 56.1	+0.7
Oct. 5	15 46 15.4	.6571227	144 3 26.7	8 48.28	+5 9 6.0	+ 1.53	60 9.6	+0.4
1799, Apr. 10	10 43 14.4	.4466944	82 59 31.3	7 26.29	+3 10 30.7	+32.59	55 28.6	+2.4
21	10 53 34.9	.4538761	239 25 14.6	8 50.42	−1 15 6.8	−47.61	60 27.0	−0.9
1800, May 5	9 28 57.4	.3951088	181 36 47.8	8 33.61	+2 18 16.1	−42.53	59 30.3	+3.6
5	10 24 57.3	.4339965	182 10 6.6	8 34.30	+2 15 30.1	−42.80	59 32.4	+3.6
July 4	10 24 22.7	.4335960	258 49 9.9	9 1.10	−4 5 53.6	−27.33	60 52.2	+1.0
Sept. 30	9 42 48.6	.4047291	343 31 19.5	7 56.04	−3 1 22.6	+35.88	57 6.7	−0.7
Nov. 26	14 13 19.1	.5925821	17 44 59.9	7 23.55	+0 0 32.2	+39.95	55 18.8	−1.8
1801, Jan. 5	18 29 59.8	.7708307	174 9 34.3	7 39.58	+1 39 1.5	−38.16	56 22.2	+0.8
5	19 25 33.6	.8094164	174 39 8.9	7 39.98	+1 36 33.9	−38.31	56 23.8	+0.8
Mar. 30	13 57 7.0	.5813307	200 41 5.8	8 13.94	−1 3 53.0	−44.70	58 13.5	+0.8
30	15 5 43.9	.6289800	201 21 10.1	8 14.34	−1 7 25.7	−44.60	58 14.9	+0.8
Apr. 24	7 28 49.7	.3116861	165 14 43.0	7 42.46	+2 6 34.8	−38.74	56 28.0	+3.8
May 21	9 41 25.0	.4037616	161 44 5.4	7 29.82	+2 14 46.6	−36.16	55 47.2	+4.0
24	8 51 12.0	.3688889	200 28 54.7	8 13.85	−1 7 57.5	−42.96	58 21.7	+4.0
24	10 1 8.3	.4174572	201 8 55.3	8 14.66	−1 11 26.2	−42.96	58 24.3	+4.0
Oct. 23	12 0 0.0	.5000000	56 51 56.8	7 41.93	+4 22 24.3	+22.56	56 11.7	−1.4
23	13 12 0.0	.5500000	57 30 25.3	7 41.38	+4 24 16.3	+22.14	56 9.7	−1.4
23	14 24 0.0	.6000000	58 8 51.2	7 40.85	+4 26 6.3	+21.69	56 7.8	−1.4
1802, Mar. 14	12 6 23.8	.5044422	124 48 35.2	7 5.22	+3 48 7.8	−27.26	54 3.6	+0.7
July 23	14 30 0.0	.6041667	57 8 39.3	7 47.10	+4 58 43.1	+11.06	56 37.0	−3.3
23	15 42 0.0	.6541667	57 47 34.2	7 46.68	+4 59 37.5	+10.63	56 35.1	−3.3
Nov. 3	4 52 56.0	.2034260	319 14 57.1	8 27.06	−1 46 51.9	+42.33	59 12.1	+3.5
3	7 52 13.7	.3279364	321 0 15.9	8 27.92	−1 38 1.3	+42.85	59 15.2	+3.5
1803, Mar. 3	6 11 40.9	.2581123	110 15 17.4	7 24.89	+3 33 35.1	−30.39	55 19.5	+0.4
3	7 26 27.6	.3100417	110 53 46.9	7 24.49	+3 30 56.4	−30.64	55 17.8	+0.4
1804, July 17	9 28 28.4	.3947731	240 5 11.2	7 9.41	−4 46 13.0	+16.64	54 16.8	+1.5
Dec. 14	14 0 0.0	.5833333	57 21 53.9	9 5.85	+4 26 25.6	−25.69	61 8.1	−0.2
14	15 12 0.0	.6333333	58 7 13.9	9 6.14	+4 24 15.5	−26.21	61 9.2	−0.2
1805, Aug. 6	7 29 40.1	.3122696	273 8 20.3	7 4.93	−1 12 9.5	+37.93	54 6.1	+0.4
Sept. 7	8 2 41.5	.3352024	330 11 27.8	7 33.10	+3 36 55.2	+28.14	55 39.0	+0.5
7	9 14 45.7	.3852510	330 49 16.5	7 33.55	+3 39 15.5	+27.82	55 40.6	+0.5
1806, June 16	4 22 0.0	.1819444	84 45 7.9	8 48.44	+0 19 16.8	−48.85	60 16.6	. . .
16	5 34 0.0	.2319444	85 29 10.8	8 48.75	+0 15 12.6	−48.92	60 17.9	. . .
1807, Dec. 14	12 36 36.2	.5254188	82 3 21.1	7 46.50	−1 55 33.9	−39.81	56 31.8	+0.9
14	13 25 37.2	.5594582	82 29 49.5	7 46.83	−1 57 49.2	−39.67	56 32.9	+0.9
1808, Apr. 5	17 25 30.9	.7260519	130 52 13.8	8 16.37	−5 6 25.7	− 8.57	58 23.4	+2.9
May 3	16 0 49.9	.6672440	139 24 18.8	8 10.81	−5 17 25.7	− 1.52	58 3.8	+2.7
Oct. 31	8 35 12.3	.3577810	11 19 27.4	7 10.30	+2 44 9.0	−34.08	54 19.5	+0.2
1809, Feb. 27	8 17 2.0	.3451618	129 45 16.7	7 52.59	−5 4 19.8	+ 3.64	56 47.5	+2.1
Apr. 3	14 37 9.3	.6091354	241 26 5.2	8 46.97	+2 29 53.0	+42.70	60 14.7	−1.3
3	15 48 5.2	.6583935	242 9 20.3	8 46.77	+2 33 22.7	+42.35	60 13.8	−1.3
29	16 32 56.5	.6895428	221 40 35.3	9 1.98	+0 47 8.8	+49.65	61 3.6	+0.3
29	17 58 22.2	.7488680	222 34 11.4	9 2.23	+0 52 3.1	+49.51	61 4.4	+0.3
May 28	11 50 17.8	.4932615	242 6 47.9	9 8.71	+2 33 5.0	+43.41	61 23.5	+0.2
June 23	13 13 50.7	.5512812	221 43 39.3	8 44.07	+0 55 18.7	+45.95	60 9.1	+2.2
28	21 13 39.6	.8844860	301 42 17.6	8 49.63	+5 3 18.4	− 0.80	60 9.7	−1.0
28	22 27 11.2	.9355461	302 27 20.4	8 49.00	+5 3 12.7	− 1.36	60 7.5	−1.0
Sept. 28	9 37 46.0	.4012267	64 16 39.4	7 9.84	−3 24 5.2	−30.17	54 25.4	+1.0
Nov. 12	10 29 19.2	.4370276	301 18 52.7	8 32.35	+5 11 23.3	− 6.11	59 18.5	+1.0
12	11 54 47.6	.4963841	302 9 31.8	8 31.60	+5 10 45.2	− 6.75	59 16.0	+1.0
Dec. 15	10 10 13.7	.4237696	17 37 37.5	7 28.68	+0 24 36.9	−39.90	55 43.4	+1.4
1810, Jan. 15	13 23 39.3	.5580938	64 38 29.5	7 7.66	−3 35 19.5	−26.15	54 13.6	+1.9
15	13 53 51.4	.5790672	64 53 26.4	7 7.62	−3 36 14.3	−26.01	54 13.3	+1.9
Feb. 18	14 41 52.8	.6124167	145 48 48.3	7 15.72	−3 54 47.7	+25.66	55 9.1	+1.6
May 10	9 12 28.3	.3836609	130 34 36.2	7 9.68	−4 39 10.7	+17.21	54 23.6	+2.7
June 15	11 57 32.4	.4982917	245 11 11.9	8 52.44	+4 2 7.3	+27.86	60 23.3	+1.1
July 25	13 41 32.4	.5705139	63 32 43.7	7 17.94	−4 10 7.0	−21.82	54 52.6	−0.4
25	14 27 13.4	.6022384	63 55 52.7	7 17.73	−4 11 16.3	−21.64	54 51.6	−0.4
Sept. 18	9 54 7.8	.4125902	66 25 9.8	7 30.00	−4 36 51.7	−20.10	55 39.6	−1.0
18	10 47 7.4	.4493911	66 52 45.5	7 29.62	−4 38 5.4	−19.79	55 38.0	−1.0
1811, Jan. 19	15 47 52.1	.6582418	236 40 42.9	8 11.00	+4 19 52.8	+22.72	58 7.7	+0.1
Mar. 1	6 40 0.0	.2777778	66 41 36.9	7 38.55	−4 58 8.4	−14.09	56 11.3	+2.3
1	7 52 0.0	.3277778	67 19 48.4	7 37.81	−4 59 18.1	−13.69	56 8.9	+2.3
1	9 4 0.0	.3777778	67 57 56.7	7 37.30	−5 0 25.6	−13.24	56 6.5	+2.3
7	11 1 44.7	.4595451	141 22 38.5	7 5.48	−3 1 43.1	+32.16	54 0.0	+1.7
27	7 33 14.8	.3147546	49 0 32.4	8 11.58	−4 12 45.5	−27.31	58 5.5	. . .
July 15	22 37 56.3	.9430127	66 17 25.2	7 46.27	−4 58 23.8	− 9.01	56 29.1	−0.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1811, July 26	15 0 55.7	.6256446	195 56 53.2	7 12.70	+2 25 21.3	+34.62	54 41.7	+1.2
Aug. 26	9 4 44.2	.3782893	238 51 48.0	7 41.77	+5 0 56.6	+13.35	56 22.0	+1.4
Sept. 2	9 24 1.9	.3916886	338 45 12.1	9 8.21	+0 47 8.0	−50.26	61 25.3	−0.7
2	11 29 35.4	.4788819	340 4 52.1	9 8.18	+0 39 49.2	−50.35	61 25.3	−0.7
17	7 8 0.0	.2972222	174 4 49.8	7 5.41	+0 37 32.0	+39.16	54 1.2	...
Oct 8	20 13 10.0	.8424768	105 49 5.0	7 27.12	−4 35 54.7	+19.62	55 30.7	−1.2
8	21 18 33.0	.8878819	106 22 54.4	7 26.60	−4 34 24.5	+19.94	55 28.8	−1.2
23	6 30 20.3	.2710683	283 23 25.8	8 5.23	+4 36 12.3	−19.79	57 45.5	+2.4
23	13 19 50.3	.5554433	287 14 2.9	8 7.96	+4 26 9.7	−22.46	57 56.1	+2.4
27	5 7 46.5	.2137362	338 35 57.0	8 42.27	+0 41 48.8	−46.71	60 3.1	+2.6
1812, Jan. 23	7 4 36.5	.2948669	67 0 2.8	8 1.46	−5 11 20.4	− 1.24	57 24.9	+2.3
23	7 34 32.4	.3156528	67 16 43.6	8 1.37	−5 11 22.9	− 1.08	57 24.3	+2.3
Apr 14	5 40 48.7	.2366748	67 31 18.7	8 34.56	−5 8 27.2	+ 0.44	59 21.6	+2.2
14	6 22 27.0	.2655903	67 56 6.0	8 34.08	−5 8 25.5	+ 0.73	59 20.0	+2.2
May 24	20 25 39.7	.8511540	232 51 30.8	7 24.58	+4 54 57.1	+ 7.18	55 1.6	−0.9
July 30	15 34 38.5	.6492883	39 26 57.5	8 28.84	−4 56 44.2	−15.66	59 6.8	−0.8
Aug. 28	18 53 6.3	.7868786	66 11 5.3	8 19.89	−5 14 48.6	+ 5.72	58 35.1	−0.5
28	19 50 54.1	.8270152	66 44 31.2	8 19.50	−5 14 24.7	+ 6.10	58 33.6	−0.5
Oct. 19	13 2 36.0	.5434724	21 59 35.1	9 12.02	−4 8 41.9	−28.08	61 28.1	+0.2
19	15 16 20.3	.6363463	23 25 3.3	9 12.24	−4 12 59.1	−27.11	61 28.6	+0.2
21	10 8 47.8	.4227757	50 44 37.8	9 5.44	−5 2 7.6	− 5.22	61 3.1	−0.1
21	11 3 51.1	.4610084	51 19 22.7	9 5.00	−5 2 26.7	− 4.74	61 1.9	−0.1
22	8 21 40.9	.3483904	64 37 53.2	8 54.04	−5 1 11.7	+ 6.30	60 27.4	−0.2
22	9 16 26.0	.3864120	65 11 42.8	8 53.52	−5 9 46.7	+ 6.78	60 25.7	−0.2
22	11 46 30.1	.4906261	66 44 15.5	8 52.01	−4 59 29.5	+ 7.98	60 20.9	−0.2
22	12 39 31.1	.5274433	67 16 52.8	8 51.48	−4 58 59.3	+ 8.44	60 19.2	−0.2
Nov. 24	17 14 33.7	.7184455	146 16 7.3	7 30.08	+0 14 36.4	+39.71	55 52.0	+0.2
24	17 33 34.2	.7316457	146 26 1.3	7 29.89	+0 15 28.8	+39.68	55 51.4	+0.2
Dec. 10	13 3 24.2	.5440300	342 12 20.5	8 11.49	−1 46 47.4	−40.96	58 18.0	+2.9
10	14 5 45.9	.5873367	342 47 50.0	8 11.94	−1 49 44.7	−40.82	58 19.6	+2.9
14	14 7 37.3	.5886262	39 52 29.8	8 51.74	−4 58 24.2	− 9.42	60 19.3	+3.8
16	4 40 0.0	.1944444	63 42 25.6	8 54.62	−4 57 41.7	+10.08	60 24.5	+3.8
16	5 52 0.0	.2444444	64 26 58.7	8 54.49	−4 56 49.7	+10.64	60 24.0	+3.8
16	7 4 0.0	.2944444	65 11 30.9	8 54.40	−4 55 54.7	+11.30	60 23.6	+3.8
16	8 16 0.0	.3444444	65 56 2.5	8 54.20	−4 54 56.8	+11.83	60 23.0	+3.8
16	9 28 0.0	.3944444	66 40 33.2	8 54.06	−4 53 55.9	+12.48	60 22.5	+3.8
16	10 40 0.0	.4444444	67 25 3.2	8 53.84	−4 52 52.0	+13.06	60 21.9	+3.8
16	11 52 0.0	.4944444	68 9 32.2	8 53.72	−4 51 45.1	+13.57	60 21.3	+3.8
1813, Mar. 6	8 50 23.7	.3683299	39 52 26.0	8 45.28	−5 9 10.2	− 7.85	59 58.6	+2.9
8	6 17 14.8	.2619769	67 9 9.6	8 30.57	−4 58 40.3	+14.06	59 13.4	+3.7
Apr. 8	5 41 58.5	.2374827	118 25 20.6	7 56.78	−1 41 59.7	+40.08	57 25.9	+4.2
8	6 54 15.1	.2876748	119 5 12.1	7 56.14	−1 38 38.2	+40.17	57 23.7	+4.2
10	5 19 13.4	.2216829	144 5 24.4	7 35.76	+0 33 11.4	+40.33	56 6.5	...
10	6 33 12.1	.2730576	144 44 25.3	7 35.38	+0 36 38.4	+40.22	56 4.7	...
17	10 24 42.6	.4338264	231 40 55.7	7 7.37	+5 0 12.0	− 3.20	53 58.6	−0.4
17	11 36 4.9	.4833900	232 16 13.8	7 7.36	+4 59 55.3	− 3.52	53 58.7	−0.4
July 11	11 2 53.3	.4603390	270 27 49.9	7 18.33	+3 2 49.4	−30.54	54 46.7	−0.6
12	12 56 53.3	.5395080	283 42 6.9	7 24.92	+2 22 21.8	−36.34	55 12.5	−1.2
Aug. 13	11 52 57.9	.4951145	343 55 48.5	8 9.64	−2 54 21.6	−37.51	57 55.7	−1.4
Sept. 14	12 31 41.5	.5220080	50 57 38.8	8 39.77	−5 3 26.9	+ 9.03	59 40.2	−0.2
Nov. 29	5 50 37.8	.2434930	321 8 14.7	7 28.18	−1 37 18.8	−38.09	55 41.9	+1.3
Dec. 28	7 33 33.9	.3149754	344 10 32.9	7 42.51	−3 34 27.9	−31.03	56 28.0	+2.2
1814, Jan. 1	9 22 53.4	.3908959	39 35 17.5	8 38.47	−5 12 20.0	+ 6.75	59 38.3	+4.8
28	8 43 31.7	.3635614	35 14 19.8	8 19.28	−5 16 40.3	+ 3.24	58 33.1	+4.5
Feb. 1	11 37 58.7	.4847072	94 22 0.0	8 48.50	−2 23 49.9	+43.47	60 18.0	+6.1
Oct. 1	10 29 32.1	.4371771	38 51 14.1	8 16.48	−4 42 26.2	+15.02	58 13.4	−0.1
1	11 30 20.7	.4794062	39 26 11.2	8 16.76	−4 41 21.6	+15.45	58 14.5	−0.1
Nov. 29	19 36 41.2	.8171435	106 35 58.3	8 51.09	+0 17 11.9	+48.32	60 30.3	+1.4
1816, Apr. 12	8 59 53.9	.3749294	211 6 47.7	8 54.53	+3 38 38.9	−33.13	60 31.1	+4.4
Dec. 7	7 34 43.5	.3157812	110 43 58.6	7 55.98	+3 42 8.7	+31.15	57 6.2	+1.1
1817, Dec. 30	14 53 17.1	.6203367	186 40 1.5	8 12.48	+3 17 24.6	−33.77	58 18.0	+2.9
1818, Feb. 13	6 7 52.0	.2554628	60 44 44.1	7 4.55	+1 36 15.9	+35.60	54 13.8	+0.8
13	6 32 29.2	.2725600	60 56 49.9	7 4.55	+1 37 16.8	+35.56	54 13.8	+0.8
Apr. 12	7 51 18.7	.3272998	101 10 27.6	7 11.89	+4 40 19.4	+18.36	54 32.2	+2.6
1819, Sept. 8	15 10 37.8	.6323820	49 31 19.4	7 48.09	+3 14 12.8	+33.61	56 50.0	−2.3
Oct. 9	14 46 30.9	.6156355	94 55 23.6	7 17.10	+5 15 4.8	+ 4.38	54 49.3	−1.4
1820, Feb. 1	10 27 20.3	.4356517	161 7 42.3	7 5.27	+1 54 4.8	−35.37	54 2.4	+0.6
1	11 36 6.9	.4834132	161 41 33.7	7 5.32	+1 51 15.5	−35.51	54 2.8	+0.6
Apr. 23	7 24 47.1	.3088785	161 40 33.0	7 6.76	+1 47 15.0	−36.65	54 15.5	+1.9
Aug. 28	11 56 24.6	.4975069	45 11 26.4	8 20.02	+4 10 16.2	+28.05	58 41.4	−3.0

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	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1820, Aug. 28	12 59 29.3	.5413113	45 47 55.5	8 19.39	+4 12 18.6	+27.62	58 39.1	−3.0
1821, Feb. 6	5 50 0.0	.2430555	11 51 6.2	8 43.06	+2 28 0.5	+42.28	60 3.0	+1.3
6	7 2 0.0	.2930555	12 34 40.8	8 42.70	+2 31 31.3	+41.94	60 1.7	+1.3
6	12 20 10.1	.5140058	15 46 51.7	8 41.00	+2 46 43.4	+40.47	59 55.8	+1.3
12	6 49 13.0	.2841782	94 55 15.9	7 46.54	+4 54 4.8	−15.29	56 31.5	+1.5
May 6	9 18 13.4	.3876551	111 16 50.1	7 54.12	+3 53 56.4	−26.87	57 9.2	+1.3
6	9 32 6.6	.3972986	111 24 27.3	7 53.92	+3 53 30.3	−26.96	57 8.7	+1.3
July 22	11 12 57.2	.4673286	41 23 26.1	8 29.58	+4 45 13.5	+18.48	59 9.7	−2.0
23	12 40 0.0	.5277778	56 22 4.9	8 26.85	+5 7 53.1	+ 6.90	58 55.9	−2.0
23	13 52 0.0	.5777778	57 4 19.0	8 26.70	+5 8 26.6	+ 6.38	58 55.2	−2.0
23	15 4 0.0	.6277778	57 46 32.4	8 26.47	+5 8 57.2	+ 5.79	58 54.4	−2.0
25	15 14 38.8	.6351713	85 45 46.1	8 16.10	+4 51 28.2	−15.82	58 13.6	−1.7
Sept. 10	8 49 20.2	.3675949	332 38 58.7	8 42.32	−0 11 6.2	+48.20	59 56.9	+0.8
Oct. 8	5 33 41.3	.2317280	353 21 54.2	8 55.50	+1 42 52.5	+45.54	60 42.0	+1.9
13	9 10 0.0	.3819444	56 18 19.9	8 58.67	+5 5 18.7	+ 6.10	60 42.7	−1.9
13	10 22 0.0	.4319444	57 3 11.9	8 58.02	+5 5 47.6	+ 5.42	60 40.8	−1.9
15	8 53 8.5	.3702372	85 16 57.1	8 28.82	+4 45 52.9	−16.84	59 8.1	−2.4
15	9 33 22.8	.3981805	85 40 38.6	8 28.39	+4 45 5.3	−17.09	59 6.6	−2.4
Dec. 7	8 0 0.0	.3333333	56 46 57.1	9 3.53	+5 1 2.8	+ 1.27	60 54.8	+1.6
7	9 12 0.0	.3833333	57 32 15.0	9 3.58	+5 1 7.5	+ 0.61	60 54.8	+1.6
1822, Feb. 8	10 0 0.0	.4166667	171 46 16.2	7 33.22	−2 21 44.6	−37.43	55 47.9	+2.2
8	11 12 0.0	.4666667	172 24 0.9	7 32.66	−2 24 51.1	−37.13	55 46.1	+2.2
27	6 5 29.9	.2538182	57 28 1.1	8 33.16	+5 15 49.8	− 1.79	59 19.9	+2.0
27	6 30 28.9	.2711678	57 42 51.3	8 33.04	+5 15 46.5	− 1.97	59 19.6	+2.0
Apr. 30	12 42 58.9	.5298484	162 28 12.5	7 28.92	−1 45 17.3	−37.04	55 39.8	+3.4
May 1	7 31 57.2	.3138565	172 10 58.3	7 23.20	−2 31 36.7	−33.64	55 14.5	+3.6
1	7 53 55.6	.3291157	172 22 14.6	7 23.16	−2 32 28.2	−33.53	55 14.1	+3.6
Aug. 10	9 0 0.0	.3750000	56 45 15.9	8 33.47	+5 11 25.9	− 8.60	59 21.5	−1.8
10	10 12 0.0	.4250000	57 28 4.4	8 33.70	+5 10 41.0	− 9.27	59 22.2	−1.8
Sept. 6	14 6 6.0	.5875693	56 35 35.1	8 33.60	+5 7 34.0	− 8.64	59 20.9	−2.1
Oct. 31	5 30 0.0	.2291667	56 34 21.0	9 3.85	+4 50 21.3	−11.98	60 56.9	−1.7
31	6 42 0.0	.2791667	57 19 40.1	9 3.71	+4 49 19.8	−12.51	60 56.9	−1.7
31	7 54 0.0	.3291667	58 4 58.8	9 3.62	+4 48 15.1	−13.17	60 56.8	−1.7
Nov. 30	7 39 38.2	.3191921	96 39 38.6	9 1.42	+2 41 39.5	−40.66	61 0.8	−1.5
Dec. 25	3 20 0.0	.1388889	56 17 45.7	8 58.13	+4 54 49.2	−15.73	60 42.0	+2.2
25	4 32 0.0	.1888889	57 2 37.6	8 58.63	+4 53 28.5	−16.48	60 43.9	+2.2
25	5 44 0.0	.2388889	57 47 32.3	8 59.20	+4 52 4.7	−16.97	60 45.7	+2.2
1823, Jan. 23	6 59 31.2	.2913327	82 19 19.7	.....	+3 42 53.2	.....	60 33.2	...
24	6 0 19.6	.2502268	96 36 12.0	8 57.72	+2 40 10.0	−42.91	60 47.3	+2.3
24	6 8 47.6	.2561060	96 41 27.8	.....	+2 39 44.8	.....	60 47.3	+2.3
24	7 34 45.5	.3158044	97 34 59.0	8 57.84	+2 35 26.9	−43.35	60 47.7	+2.3
Apr. 13	8 59 42.0	.3747910	57 39 0.9	.....	+4 34 7.4	.....	59 40.7	...
13	9 3 1.4	.3771116	57 41 1.7	.....	+4 34 3.0	.....	59 40.8	...
May 18	8 55 21.7	.3717789	166 39 33.9	7 59.45	−3 41 57.5	−29.06	57 27.9	+3.2
June 17	10 56 3.6	.4555972	203 43 6.8	7 35.62	−5 11 23.8	− 3.21	55 53.9	+3.7
20	9 49 29.0	.4093640	240 10 16.5	.....	−4 24 56.3	.....	54 31.8	...
Sept. 23	7 7 45.0	.2970486	41 53 17.9	8 8.74	+4 51 9.1	−12.14	57 47.9	−1.1
1824, Jan. 7	6 6 43.8	.2546736	356 8 52.4	7 19.98	+4 54 5.4	+15.48	55 0.5	+3.8
Mar. 4	6 33 27.8	.2732379	27 38 48.2	.....	+4 59 34.3	.....	55 57.3	...
5	8 23 25.1	.3495962	41 27 30.9	.....	+4 37 9.5	.....	56 33.0	...
12	7 28 51.3	.3117049	138 23 21.0	8 55.34	−2 41 10.4	−40.18	60 39.5	+2.4
12	12 55 22.8	.5384584	141 45 53.3	8 56.40	−2 56 4.9	−38.65	60 41.9	+2.4
Apr. 5	7 43 49.3	.3220985	91 39 16.7	8 16.04	+1 2 58.7	−42.75	58 33.2	+2.5
5	9 6 40.2	.3796314	92 26 51.7	.....	+0 58 32.4	.....	58 34.7	+2.5
Sept. 4	8 53 44.1	.3706495	302 52 24.1	7 6.82	+2 10 16.2	+34.18	54 11.0	+3.4
30	6 41 19.0	.2786927	286 33 14.6	.....	+1 1 43.9	.....	54 56.3	...
30	9 21 3.2	.3896197	287 53 41.6	.....	+1 8 39.8	.....	54 52.9	...
Nov. 29	7 32 54.1	.3145152	350 39 22.0	7 9.10	+5 10 0.3	+ 6.71	54 19.0	+2.7
Dec. 7	5 59 56.9	.2499643	92 28 20.5	8 19.90	−0 12 7.4	−46.05	58 35.5	−0.5
31	12 4 46.3	.5033138	49 58 3.5	7 44.43	+3 25 28.6	−32.56	56 32.2	+1.9
1825, Jan. 3	8 16 59.4	.3451319	88 11 23.2	8 23.93	+0 11 53.3	−46.46	58 51.1	+0.7
Feb. 11	16 32 50.3	.6894710	258 40 8.5	7 40.37	−0 55 10.2	+40.60	56 25.6	−0.3
27	9 43 45.2	.4053844	91 7 15.0	.....	−0 19 34.6	.....	57 59.3	+3.5
27	9 51 6.5	.4104918	91 11 23.3	8 5.73	−0 19 56.5	−42.91	57 59.6	+3.5
Mar. 24	9 2 17.0	.3765856	61 23 2.9	7 26.69	+1 58 15.9	−36.14	55 31.0	+3.6
24	9 19 39.2	.3886481	61 32 1.5	7 26.76	+1 57 32.2	−36.20	55 31.4	+3.6
28	7 17 5.3	.3035336	112 26 13.9	8 15.20	−2 22 50.7	−38.46	58 30.4	+3.8
Apr. 1	7 26 57.4	.3103865	170 55 58.6	9 8.67	−5 1 9.4	− 2.50	61 13.3	+3.0
June 27	11 10 34.6	.4656782	244 57 50.1	8 17.05	−1 27 38.6	+43.96	58 27.4	+3.3
27	11 13 0.4	.4673660	244 59 14.1	.....	−1 27 31.3	.....	58 27.3	+3.3

Date.		Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
		h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1825, July	4	13 5 28.3	.5454664	336 44 7.5	7 16.25	+5 4 47.4	+ 9.61	54 40.8	+0.1
	4	13 58 42.7	.5824386	337 11 0.0	7 16.09	+5 5 22.5	+ 9.30	54 39.9	+0.1
	25	10 42 9.5	.4459431	254 42 56.2	.....	−0 30 54.5	.....	57 40.1	...
	27	12 17 38.2	.5122476	281 58 46.4	7 47.50	+1 53 55.0	+39.08	56 38.4	+3.8
	27	13 4 12.2	.5445856	282 23 57.9	7 47.22	+1 56 1.1	+38.97	56 37.5	+3.8
	27	15 48 17.2	.6585324	283 52 38.4	7 46.44	+2 3 22.5	+38.44	56 34.1	+3.8
	28	10 23 25.8	.4329374	293 51 11.9	.....	+2 50 32.3	.....	56 10.5	...
Aug.	8	20 10 5.2	.8403380	72 53 58.9	7 38.32	+0 34 59.1	−40.69	56 18.4	+2.0
	8	21 24 9.2	.8917732	73 33 17.5	7 39.04	+0 31 29.5	−40.81	56 20.9	+2.0
	22	8 59 12.4	.3744485	264 1 9.1	.....	+0 29 27.1	.....	57 12.3	...
	22	14 25 21.9	.6009480	65 41 20.1	7 21.76	+0 58 15.3	−38.24	55 19.6	...
Sept.	4	13 17 39.8	.5539329	65 6 44.5	7 21.25	+1 1 14.7	+38.09	55 17.9	+1.2
	23	7 1 24.5	.2926447	323 11 9.8	7 18.23	+4 39 19.2	+14.29	54 44.8	+4.7
	24	9 58 31.0	.4156366	336 46 57.2	7 13.50	+4 57 51.7	+ 5.38	54 22.6	+4.7
Dec.	14	4 55 47.9	.2054155	323 20 29.4	7 35.60	+5 0 40.2	+13.22	55 55.8	+2.8
1826, Jan.	13	5 23 42.8	.2248010	356 4 23.6	7 16.80	+4 59 5.7	−10.16	54 43.8	+3.7
Feb.	15	7 27 0.4	.3104213	64 25 49.4	7 13.84	+0 20 43.7	−38.30	54 50.3	+4.2
	16	4 44 11.9	.1973600	75 12 48.1	7 21.93	−0 36 24.7	−38.79	55 19.6	+4.1
May	12	9 10 21.6	.3821945	115 58 46.4	7 35.36	−4 15 0.2	−24.95	55 58.4	+3.5
	13	8 38 18.0	.3599306	128 29 44.5	7 46.67	−4 49 54.5	−17.50	56 39.1	+3.7
July	27	11 58 7.5	.4986979	46 26 30.1	7 4.94	+1 14 39.9	−36.78	54 14.7	+0.7
Sept.	13	10 39 34.9	.4441539	323 7 58.0	7 53.15	+5 2 49.3	+ 2.00	56 48.3	+2.8
	21	10 8 44.0	.4227315	61 25 32.2	7 3.97	−0 34 7.4	−37.82	54 9.4	+1.1
Oct.	24	15 31 20.8	.6467686	133 23 53.4	7 45.57	−5 10 41.1	− 7.67	56 34.9	+0.7
1827, Jan.	5	10 37 15.1	.4425360	25 0 36.1	7 12.76	+2 21 35.7	−34.48	54 44.0	+2.4
	14	9 28 22.6	.3947062	132 51 51.2	7 36.71	−4 59 57.2	− 6.00	55 46.2	+1.2
	14	10 34 24.3	.4405591	133 26 46.0	7 36.98	−5 0 23.8	− 5.59	55 47.4	+1.2
	19	14 53 29.1	.6204758	201 49 48.0	8 14.50	−2 28 3.4	−38.27	58 26.6	−0.4
Feb.	10	12 4 10.2	.5028960	130 21 5.3	7 40.77	−4 56 55.5	− 5.88	56 0.3	+1.7
July	2	8 51 30.6	.3691043	197 12 1.8	8 6.90	−2 12 2.8	+39.24	58 1.8	+3.0
	2	9 3 13.8	.3772430	197 18 36.8	8 6.90	−2 11 30.9	+39.28	58 2.2	+3.0
	7	11 1 34.6	.4594284	270 57 30.9	9 7.25	+3 48 4.6	+31.98	61 14.3	+1.0
Aug.	1	8 20 35.7	.3476353	234 31 36.3	8 28.30	+1 15 58.9	+43.37	59 17.3	+2.2
	29	6 21 50.0	.2651619	243 56 52.7	8 24.50	+2 17 23.8	+40.10	59 1.8	+2.5
Oct.	12	14 28 44.9	.6032976	109 37 49.3	7 8.74	−5 4 19.8	−10.64	54 18.9	+0.7
Nov.	16	5 1 40.2	.2094930	201 20 31.2	8 19.93	−1 16 22.6	+44.68	58 40.4	+0.2
	28	10 3 19.4	.4189745	14 37 44.6	7 39.96	+1 49 51.9	−39.38	56 18.8	+1.8
Dec.	8	15 59 41.7	.6664549	138 41 1.4	7 11.73	−4 59 48.7	+ 9.53	54 26.6	+0.7
	8	17 21 53.2	.7235325	139 22 6.0	7 11.89	−4 58 52.7	+ 9.98	54 27.9	+0.7
1828, Jan.	31	11 24 55.6	.4756436	130 17 4.6	7 11.64	−4 54 26.7	+ 7.07	54 11.5	+1.2
Feb.	22	7 31 7.2	.3132777	65 22 34.8	7 17.50	−3 8 23.6	−30.83	55 0.0	+1.5
Mar.	23	8 4 50.6	.3366968	97 42 33.5	7 8.53	−4 58 27.1	−12.32	54 18.7	+2.1
	24	9 12 3.7	.3833761	110 8 38.2	7 7.28	−5 12 52.3	− 4.12	54 11.3	+2.1
	24	10 19 35.4	.4302708	110 42 1.9	7 7.30	−5 13 10.7	− 3.70	54 11.2	+2.1
	31	11 58 54.0	.4992361	198 5 28.2	8 30.55	−0 43 13.2	+46.48	56 56.8	−0.6
June	16	8 19 38.3	.3469710	133 53 18.4	7 6.40	−4 45 29.9	+12.93	54 3.2	+1.8
Aug.	16	12 6 59.8	.5048589	214 32 2.3	7 38.89	+1 26 54.7	+39.48	56 20.1	+2.2
	28	9 23 36.5	.3913948	25 22 15.0	8 17.58	−0 42 32.7	−44.59	58 38.0	−1.1
1829, Jan.	18	8 49 27.5	.3676795	105 47 56.6	7 19.29	−4 59 47.3	+ 3.53	54 40.7	+2.9
Apr.	12	5 51 6.3	.2438229	130 53 5.9	7 9.10	−4 24 54.0	+21.70	54 21.6	+2.8
June	13	10 36 20.4	.4419029	221 34 27.8	7 37.40	+3 3 10.3	+31.98	56 3.4	+1.7
	13	10 55 17.2	.4550601	221 44 28.6	7 37.50	+3 3 52.4	+31.99	56 4.0	+1.7
	13	11 37 36.1	.4844456	222 6 54.6	7 37.88	+3 5 26.2	+31.81	56 5.2	+1.7
July	26	12 13 17.4	.5092291	80 13 25.0	7 46.90	−5 0 57.3	− 7.18	56 30.0	−1.2
Aug.	8	12 0 0.0	.5000000	238 28 52.0	7 39.02	+4 26 39.9	+21.23	56 13.8	+1.8
	21	13 0 0.0	.5416667	64 30 32.6	8 0.10	−4 45 45.3	−18.01	57 28.5	+1.8
	21	15 24 0.0	.6416667	65 50 28.5	7 58.91	−4 48 41.1	−17.01	57 23.8	+1.8
	21	16 36 0.0	.6916667	66 30 21.9	7 58.32	−4 50 5.4	−16.53	57 21.5	+1.8
	21	17 48 0.0	.7416667	67 10 12.2	7 57.74	−4 51 27.2	−16.06	57 19.2	+1.8
	21	20 12 0.0	.8416667	68 29 44.0	7 56.57	−4 54 3.4	−15.08	57 14.7	+1.8
Sept.	18	2 3 49.8	.0859930	67 54 56.6	8 9.83	−4 57 50.4	−15.82	58 2.4	−1.6
	23	21 4 14.0	.8779398	140 55 22.1	7 9.35	−3 14 36.9	+31.41	54 18.5	+0.2
	23	21 40 53.0	.9033912	141 13 34.7	7 9.29	−3 13 6.7	+31.53	54 18.1	+0.2
Oct.	15	9 4 58.5	.3784549	66 41 27.4	8 27.38	−4 52 51.7	−17.00	58 58.6	−0.6
	15	9 48 58.6	.4090117	67 7 17.0	8 26.86	−4 53 43.4	−16.72	58 56.9	−0.6
Nov.	11	21 50 51.7	.9103208	67 59 20.2	8 34.69	−4 49 34.9	−15.02	59 17.4	+0.2
	11	22 31 13.7	.9383532	68 23 22.8	8 34.40	−4 50 16.7	−14.71	59 16.1	+0.2
Dec.	9	5 46 18.3	.2404894	66 41 55.3	8 30.90	−4 45 58.0	−13.81	59 1.6	+2.0
	9	5 51 36.3	.2441702	66 45 3.7	8 31.01	−4 46 3.1	−13.70	59 1.5	+2.0
1830, Jan.	5	14 59 7.2	.6243889	67 26 58.7	8 17.73	−4 53 37.8	−10.83	58 18.7	+2.4

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1830, Jan. 5	15 43 32.4	.6552361	67 52 34.0	8 17.64	−4 54 10.9	−10.53	58 18.0	+2.4
Mar. 2	5 54 49.8	.2464096	83 0 13.1	8 1.50	−5 16 59.6	+ 2.81	57 30.1	+2.7
2	9 24 2.9	.3917002	84 56 36.8	7 59.70	−5 16 8.2	+ 4.35	57 24.0	+3.0
3	8 50 46.2	.3685903	97 49 3.0	7 49.12	−5 1 24.1	+13.59	56 44.8	+3.0
3	9 0 13.9	.3751609	97 54 10.2	7 49.10	−5 1 15.2	+13.73	56 44.6	+3.0
28	7 20 0.0	.3055556	65 56 11.0	8 33.70	−5 7 46.3	−10.76	59 22.4	+1.9
28	8 32 0.0	.3555556	66 38 57.9	8 32.92	−5 8 38.8	−10.17	59 19.8	+1.9
28	9 44 0.0	.4055556	67 21 40.9	8 32.14	−5 9 28.4	− 9.59	59 17.2	+1.9
28	10 56 0.0	.4555556	68 4 20.0	8 31.35	−5 10 15.1	− 9.02	59 14.5	+1.9
28	12 8 0.0	.5055556	68 46 55.1	8 30.55	−5 10 58.9	− 8.46	59 11.8	+1.9
29	7 4 43.9	.2949526	79 50 28.5	8 17.92	−5 16 8.9	+ 0.52	58 29.0	+2.1
29	7 49 55.3	.3263345	80 16 30.7	8 17.47	−5 16 6.6	+ 0.83	58 27.3	+2.1
Apr. 5	7 13 27.0	.3010070	168 15 13.0	7 7.64	−0 5 40.0	+39.26	54 13.3	+3.2
28	7 18 19.4	.3043912	115 49 48.6	7 49.53	−4 4 19.4	+25.71	56 54.4	+2.7
28	7 28 0.9	.3111215	115 55 4.0	7 49.50	−4 4 12.1	+25.81	56 54.0	+2.7
May 1	11 13 3.7	.4674040	155 16 47.0	7 13.11	−1 8 36.6	+37.96	54 44.5	+3.3
1	11 28 59.7	.4784687	155 24 45.2	7 13.00	−1 7 54.6	+38.03	54 44.2	+3.3
June 4	10 10 42.5	.4241030	234 42 59.9	7 17.80	+4 41 42.9	+13.25	54 38.6	+1.5
25	8 22 30.5	.3489641	158 13 8.9	7 24.40	−0 24 7.0	+39.36	55 26.7	+2.8
July 15	22 17 53.2	.9290879	66 47 19.9	8 31.78	−5 6 43.1	− 3.69	59 9.3	−1.0
16	0 14 18.7	.0099386	67 56 17.6	8 31.60	−5 7 9.0	− 2.72	59 8.2	−1.1
Aug. 1	9 8 15.4	.3807338	275 55 15.0	7 46.80	+4 42 23.0	−17.95	56 29.7	+0.7
Sept. 5	8 31 20.4	.3550971	22 40 30.4	8 50.62	−3 34 15.5	−36.08	60 21.8	−2.4
5	9 14 11.4	.3848540	23 6 49.3	8 50.57	−3 36 2.7	−35.79	60 21.5	−2.4
Oct. 4	14 28 17.2	.6029767	50 34 14.2	8 57.75	−4 54 48.0	−16.09	60 41.0	−1.7
4	14 51 49.2	.6193193	50 48 52.9	8 57.59	−4 55 14.2	−15.84	60 40.5	−1.7
5	14 20 0.0	.5972222	65 16 43.8	8 46.64	−5 11 18.9	− 3.79	60 4.8	−1.9
5	16 44 0.0	.6972222	66 44 24.3	8 45.28	−5 11 50.9	− 2.57	60 0.5	−1.9
20	4 32 13.7	.1890475	249 1 18.8	7 9.71	+5 7 6.3	+ 0.05	54 12.4	+1.7
20	4 39 34.3	.1941470	249 4 57.7	7 9.70	+5 7 6.4	+ 0.01	54 12.5	+1.7
23	5 51 22.0	.2440046	286 8 55.0	7 28.60	+4 4 43.5	−24.22	55 37.3	+2.6
30	5 23 42.1	.2247928	22 43 15.2	9 8.13	−3 32 19.9	−34.82	61 18.1	+0.2
Nov. 4	13 39 51.6	.5693472	102 40 56.1	8 24.04	−4 10 23.5	+25.29	58 54.1	−1.1
Dec. 22	4 4 36.5	.1698670	356 52 47.7	8 12.80	−2 3 45.7	−40.02	58 22.7	+2.5
27	9 46 5.3	.4070058	72 33 8.8	8 56.70	−5 0 8.4	+ 8.10	60 31.6	−1.2
1831, Jan. 20	7 39 8.6	.3188495	23 32 44.5	8 24.76	−4 7 45.9	−28.00	58 56.7	+2.0
20	7 47 54.6	.3249376	23 37 50.7	8 24.80	−4 8 2.9	−28.03	58 56.8	+2.0
21	10 39 10.8	.4438749	39 25 35.6	8 31.38	−4 50 39.5	−17.19	59 16.3	+2.5
21	11 54 13.8	.4959931	40 10 1.7	8 31.69	−4 52 8.2	−16.69	59 17.1	+2.5
22	6 49 50.3	.2846100	51 25 6.4	8 35.50	−5 8 28.7	−79.92	59 27.3	+3.6
26	10 15 16.6	.4272755	110 52 3.2	8 29.13	−3 22 45.4	+35.41	59 2.3	+2.2
28	17 11 57.3	.7166355	142 32 7.4	8 5.00	−0 36 19.8	+44.01	57 42.8	+1.4
Feb. 4	22 22 22.1	.9322004	232 13 53.1	7 7.30	+5 12 20.5	+ 6.00	54 12.9	+1.0
4	23 47 29.2	.9913104	232 55 59.1	7 7.35	+5 12 54.6	+ 5.51	54 13.0	+1.0
19	6 45 23.4	.2815210	62 22 51.0	8 30.63	−5 17 8.9	+ 1.19	59 11.3	+2.8
19	7 12 58.2	.3006736	62 39 7.7	8 30.60	−5 17 6.5	+ 1.39	59 11.2	+2.8
19	9 17 5.3	.3868669	63 52 27.8	8 30.40	−5 16 50.2	+ 2.46	59 10.5	+2.8
19	12 15 32.3	.5107905	65 37 22.3	8 30.10	−5 16 11.7	+ 3.78	59 9.5	+2.8
19	16 27 53.2	.6860324	68 6 47.5	8 29.58	−5 14 47.2	+ 5.81	59 7.9	+2.8
20	11 52 17.6	.4946481	79 31 59.5	8 27.04	−5 0 48.1	+14.76	58 59.0	+2.9
Apr. 15	5 5 42.5	.2122975	67 43 39.8	8 55.01	−5 2 19.4	+ 6.90	60 31.0	+1.8
May 22	12 30 57.4	.5214977	201 8 16.0	7 13.73	+4 6 27.4	+21.66	54 31.2	+2.0
June 21	9 12 3.1	.3833692	232 18 57.6	7 7.28	+5 5 20.6	+ 0.65	54 1.8	+1.1
21	9 50 22.3	.4099804	232 37 53.8	7 7.30	+5 5 22.1	+ 0.45	54 1.6	+1.1
July 31	12 26 37.3	.5184872	35 2 51.7	8 24.43	−5 2 50.3	−13.29	58 51.1	−1.8
Aug. 28	21 3 28.2	.8774096	51 2 44.8	8 29.68	−5 16 2.4	− 0.55	59 6.8	−2.2
29	16 40 0.0	.6944444	62 38 6.0	8 31.47	−5 10 22.1	+ 8.82	59 14.3	−1.8
29	19 4 0.0	.7944444	64 3 21.5	8 31.58	−5 8 47.9	+ 9.95	59 15.1	−1.8
29	21 28 0.0	.8944444	65 28 38.6	8 31.76	−5 7 2.2	+11.06	59 15.7	−1.8
30	1 12 35.4	.0504096	67 41 42.0	8 31.96	−5 3 54.7	+12.88	59 16.7	...
Oct. 14	12 54 13.2	.5376528	302 33 53.3	7 19.47	+1 30 48.6	−37.40	55 10.4	+0.4
21	8 36 10.1	.3584502	34 38 4.6	8 51.36	−4 52 19.8	−11.70	60 12.2	−1.5
21	9 28 14.1	.3946076	35 10 5.9	8 51.56	−4 53 1.9	−11.32	60 13.0	−1.5
23	9 30 0.0	.3958333	64 54 10.1	8 54.67	−4 50 30.8	+12.85	60 28.1	−1.8
23	10 42 0.0	.4458333	65 38 43.0	8 54.49	−4 49 24.9	+13.38	60 27.7	−1.8
23	11 54 0.0	.4958333	66 23 15.2	8 54.30	−4 48 16.3	+13.94	60 27.3	−1.8
23	13 6 0.0	.5558333	67 7 46.3	8 54.10	−4 47 4.7	+14.52	60 26.8	−1.8
23	13 32 45.1	.5644109	67 24 19.4	8 53.90	−4 46 37.4	+14.90	60 26.6	−1.8
23	14 18 0.0	.5958333	67 52 16.4	8 53.88	−4 45 50.3	+15.12	60 26.3	−1.8
23	14 27 53.8	.6027060	67 58 24.2	8 53.90	−4 45 39.8	+15.20	60 26.3	−1.8

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1831, Nov. 8	5 32 1.0	.2305671	271 20 48.0	7 5.79	+3 35 33.6	−25.99	54 1.1	+0.6
16	11 27 1.8	.4771042	15 15 33.4	8 32.27	−4 17 28.4	−23.24	59 16.3	+0.4
24	11 11 37.4	.4664051	133 32 50.4	8 21.32	−0 10 48.3	+44.33	58 55.0	−1.2
Dec. 17	3 34 4.2	.1486597	62 40 55.5	9 5.90	−4 50 43.1	+15.90	61 6.0	+1.2
17	3 36 59.3	.1506863	62 42 46.6	9 5.96	−4 50 39.9	+15.88	61 6.0	+1.2
18	7 11 26.1	.2996076	80 14 35.5	9 12.17	−4 6 49.3	+29.44	61 28.8	+0.7
1832, Jan. 5	3 41 27.5	.1537905	311 51 42.4	7 13.80	+0 3 58.9	−39.70	54 36.3	+0.2
Feb. 10	5 5 40.3	.2122720	67 10 15.3	8 32.50	−4 48 35.7	+19.70	59 21.1	+2.7
10	6 10 27.4	.2572615	67 48 42.6	8 33.00	−4 47 6.0	+20.20	59 22.6	+2.7
15	4 57 50.1	.2068298	140 6 38.4	8 45.06	+0 41 56.7	+48.05	60 3.9	+1.7
15	17 13 48.2	.7179190	147 32 13.6	8 40.99	+1 22 16.2	+46.45	59 49.3	+1.7
15	17 17 11.5	.7202720	147 34 16.1	8 41.10	+1 22 27.2	+46.40	59 49.2	+1.7
Mar. 8	8 56 1.8	.3722431	66 6 35.2	8 24.70	−4 44 27.5	+18.70	58 52.6	+2.8
8	12 6 10.9	.5042928	67 57 44.0	8 25.21	−4 40 11.7	+19.96	58 55.0	+2.8
9	11 5 11.9	.4619433	81 26 59.7	8 28.77	−4 0 37.6	+29.29	59 11.0	+2.9
9	11 6 35.9	.4629155	81 27 47.8	8 28.80	−4 0 34.8	+29.30	59 11.0	+2.9
9	11 41 3.9	.4868507	81 48 7.0	8 28.84	−3 59 24.3	+29.48	59 11.4	+2.9
Apr. 14	8 2 59.1	.3354062	200 50 35.2	7 52.79	+4 45 30.7	+13.16	56 45.3	+2.5
June 17	19 0 25.7	.7919640	321 4 16.8	7 9.01	−1 32 50.2	−37.35	54 25.0	−1.0
17	19 43 14.5	.8216956	321 25 32.6	7 9.12	−1 34 41.2	−37.27	54 25.6	−1.0
Sept. 4	8 11 10.8	.3410972	282 44 17.8	7 4.60	+1 47 48.1	−36.30	54 9.8	0.0
7	13 33 20.4	.5648194	320 59 11.6	7 13.33	−1 36 32.6	−37.21	54 32.5	−0.7
7	14 43 31.0	.6135532	321 34 24.0	7 13.66	−1 39 33.7	−37.11	54 33.4	−1.0
Dec. 31	8 36 28.2	.3586597	28 4 2.9	7 49.90	−5 16 31.4	+ 2.80	56 49.8	+1.8
1833, Mar. 31	7 8 43.8	.2977292	138 29 28.7	8 44.20	+2 20 42.3	+40.80	60 5.8	+4.7
Dec. 26	4 47 38.6	.1997522	92 13 39.9	8 19.57	−0 20 51.4	+46.12	58 33.9	+1.1
1834, Apr. 13	7 54 36.0	.3295833	75 14 50.0	7 30.80	−1 11 1.4	+38.80	55 45.7	+2.8
20	8 40 52.2	.3617153	171 25 40.2	8 58.40	+5 2 19.1	+ 5.80	60 42.0	+5.4
Aug. 12	7 3 10.8	.2938749	240 42 1.0	8 14.19	+2 8 6.1	−40.16	58 25.8	+5.1
12	8 3 58.3	.3360913	241 16 46.8	8 13.85	+2 5 16.0	−40.31	58 24.4	+5.1
30	16 23 47.0	.6831835	111 6 57.9	8 10.91	+2 18 45.9	+38.46	58 10.0	+1.8
Oct. 7	5 32 8.3	.2306516	259 50 6.1	8 19.30	+0 0 2.9	−44.40	58 47.1	+2.8
7	5 56 8.2	.2473171	260 3 58.5	8 18.98	−0 1 11.0	−44.32	58 46.2	+2.8
7	6 6 8.8	.2542685	260 9 44.8	8 18.90	−0 1 41.7	−44.30	58 45.8	+2.8
8	6 40 59.5	.2784664	274 7 26.9	8 2.74	−1 15 20.6	−41.58	57 49.3	+2.7
8	6 50 38.9	.2851724	274 12 50.0	8 2.70	−1 15 48.5	−41.50	57 49.0	+2.7
Nov. 3	4 10 5.1	.1736702	253 19 20.2	8 43.10	+0 25 8.8	−47.30	60 3.0	+2.4
Dec. 17	13 50 30.0	.5767360	107 36 3.9	7 44.71	+2 39 8.5	+37.05	56 25.6	...
17	15 9 21.6	.6315001	108 18 29.8	7 45.07	+2 42 31.0	+36.84	56 27.2	...
1835, Jan. 6	9 45 19.2	.4064722	15 58 46.2	7 7.90	−4 35 10.5	+18.70	54 18.4	+0.1
18	12 4 28.9	.5031122	170 38 30.1	8 26.54	+5 8 38.5	− 3.14	58 52.3	+0.8
18	12 51 59.4	.5361039	171 6 21.7	8 26.64	+5 8 27.6	− 3.54	58 52.7	+0.8
Apr. 9	8 39 14.4	.3605833	151 48 52.6	8 27.10	+5 4 42.4	+ 6.10	58 57.1	+5.1
June 10	9 41 57.4	.4041365	258 35 59.8	8 58.00	−0 56 49.1	−48.80	60 49.7	+2.5
12	11 14 11.4	.4681872	288 55 56.5	8 37.26	−3 26 38.4	−36.09	59 35.5	+0.8
14	11 34 41.6	.4824262	317 1 59.2	8 6.47	−4 55 7.6	−16.08	57 46.6	−0.7
July 6	10 0 32.1	.4170382	238 10 20.7	8 45.50	+0 52 46.7	−47.10	60 11.8	+4.2
Aug. 6	5 38 32.7	.2351006	288 31 50.4	8 28.93	−3 25 3.1	−33.11	59 2.6	+2.9
6	5 45 58.7	.2402625	288 36 13.2	8 28.93	−3 25 20.1	−33.07	59 2.4	+2.9
6	6 59 52.6	.2915815	289 19 44.4	8 28.64	−3 28 8.7	−32.64	59 1.3	+2.9
8	9 39 52.7	.4026934	318 44 43.6	8 12.62	−4 49 7.4	−12.58	57 56.8	+0.6
29	5 51 30.2	.2440995	228 35 48.4	8 30.60	+1 17 56.6	−43.50	59 23.1	+5.6
Oct. 3	6 22 35.0	.2656829	335 27 48.9	7 46.80	−5 5 35.4	+ 3.60	56 26.5	+1.4
29	5 42 39.0	.2379510	319 1 8.0	7 56.42	−5 9 42.5	− 7.89	57 12.4	+2.0
Nov. 25	6 13 1.9	.2590498	315 31 22.5	8 12.60	−5 8 57.8	−10.70	58 11.3	+0.8
27	10 11 58.7	.4249853	344 10 46.6	7 41.29	−5 7 19.0	+10.98	56 19.4	...
1836, Feb. 8	11 6 55.6	.4631436	214 56 25.1	8 16.46	+1 44 6.9	−41.07	58 33.9	+1.5
23	5 35 44.2	.2331504	55 59 18.4	7 7.90	+0 12 45.6	+37.80	54 27.8	−0.4
25	8 11 50.9	.3415613	80 54 21.3	7 5.40	+2 19 30.6	+33.40	54 14.7	+0.6
Mar. 24	5 10 34.9	.2156817	87 13 41.3	7 5.60	+3 2 47.3	+31.00	54 14.7	+1.0
Apr. 25	8 26 14.4	.3515555	145 29 34.9	7 36.82	+5 14 59.6	− 3.92	56 1.1	+4.1
25	8 43 14.3	.3633600	145 38 33.3	7 36.90	+5 14 55.0	− 4.00	56 1.7	+4.1
25	9 1 23.2	.3759629	145 48 10.4	7 37.22	+5 14 49.8	− 4.13	56 2.2	+4.1
May 17	7 33 46.2	.3151180	81 12 24.7	7 5.65	+2 44 12.1	+33.58	54 1.7	−0.6
June 28	13 2 4.6	.5431078	278 29 30.2	9 9.97	−3 53 52.1	−31.95	61 22.6	+2.3
Aug. 22	6 32 33.0	.2726032	277 27 28.3	8 45.90	−4 2 33.2	−27.59	60 5.6	+4.5
22	7 56 23.5	.3308276	278 18 31.7	8 46.33	−4 5 12.1	−27.03	60 6.6	+4.5
Sept. 16	8 40 10.2	.3612291	246 44 26.3	8 22.00	−2 9 40.7	−41.01	58 51.8	+6.1
16	8 45 26.7	.3648924	246 47 30.1	8 21.97	−2 9 55.7	−41.01	58 51.9	+6.1
16	8 47 32.7	.3663507	246 48 43.3	8 21.95	−2 10 1.7	−41.00	58 51.9	+6.1

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1836, Sept. 21	8 12 51.6	.3422639	317 35 30.0	8 35.73	−5 7 7.8	+ 4.64	59 21.6	+3.3
Oct. 21	8 34 23.7	.3572183	355 38 14.3	8 7.46	−3 45 3.2	+31.44	57 46.8	+1.7
21	10 47 57.0	.4499651	356 53 32.0	8 6.73	−3 40 8.6	+32.06	57 44.3	+1.7
21	12 0 28.1	.5003249	357 34 22.1	8 6.34	−3 37 26.0	+32.46	57 42.9	+1.7
Dec. 16	8 31 39.1	.3553138	15 39 8.6	7 44.73	−2 8 39.1	+38.20	56 40.4	...
1837, Feb. 14	6 57 52.1	.2901864	82 31 49.0	7 9.40	+3 45 35.8	+25.20	54 23.7	+0.2
17	9 36 43.6	.4005045	119 25 40.6	7 7.82	+5 1 4.8	+ 2.99	54 1.4	+1.2
Mar. 12	6 13 8.8	.2591297	66 8 39.9	7 26.42	+2 53 6.2	+33.51	55 33.1	+0.3
13	9 39 4.1	.4021308	80 8 43.1	7 16.00	+3 50 23.5	+26.40	54 52.3	+0.9
15	9 0 43.5	.3755035	103 45 32.4	7 7.40	+4 54 31.2	+12.20	54 12.4	+1.1
16	6 53 18.3	.2870174	114 33 51.5	7 6.80	+5 7 42.5	+ 5.10	54 6.5	+1.5
May 10	9 21 40.7	.3900544	119 47 23.9	7 8.50	+5 14 45.6	+ 1.10	54 14.8	+1.4
June 6	8 3 44.3	.3359294	115 21 25.5	7 10.50	+5 6 15.4	+ 3.50	54 14.6	+0.1
16	6 29 40.7	.2706105	239 41 2.3	8 29.31	−2 30 29.1	−39.51	59 9.3	+5.1
July 9	6 47 8.9	.2827420	182 51 5.6	7 17.98	+2 8 6.5	−34.91	55 2.4	+4.3
Aug. 18	10 6 59.2	.4215186	3 25 34.4	8 43.94	−1 47 59.1	+43.61	60 5.3	−1.2
18	11 11 14.2	.4661367	4 4 30.5	8 43.15	−1 44 44.2	+43.71	60 3.1	−1.2
Oct. 9	6 36 46.4	.2755371	319 10 9.8	8 43.78	−4 43 15.0	+21.51	59 56.6	+4.3
9	7 47 38.7	.3247536	319 53 8.3	8 44.05	−4 41 27.3	+22.05	59 57.6	+4.3
Nov. 5	6 32 6.4	.2722963	315 27 2.3	8 30.39	−4 49 49.9	+18.24	59 12.8	+5.2
10	8 9 6.2	.3396551	27 17 14.1	8 23.00	+0 26 56.2	+45.90	58 47.3	+1.3
12	12 41 2.0	.5284954	57 21 44.9	8 4.81	+3 0 0.5	+36.09	57 36.6	−0.7
1838, Jan. 3	3 8 27.0	.1308681	17 21 19.5	8 13.60	−0 5 53.4	+43.50	58 27.3	+2.0
Feb. 2	9 8 0.8	.3805652	57 40 34.1	7 49.40	+3 25 23.0	+30.77	56 54.4	...
4	7 6 31.9	.2962025	82 9 50.2	7 32.10	+4 40 8.8	+15.60	55 40.9	+0.5
7	7 49 28.9	.3260289	119 25 41.3	7 15.10	+4 54 29.9	− 9.60	54 26.6	+0.8
Mar. 1	4 33 12.0	.1897222	51 16 33.2	8 9.00	+3 11 33.8	+35.20	58 7.0	+0.3
29	4 14 34.0	.1767824	59 33 24.4	8 15.67	+3 50 14.1	+31.46	58 24.2	+0.6
June 4	7 52 56.7	.3284340	213 23 9.4	7 25.60	−1 54 35.7	−36.70	55 22.5	+5.2
July 31	9 16 19.2	.3863333	242 43 53.4	7 42.27	−4 16 28.8	−22.45	56 23.8	+6.2
Aug. 12	13 45 22.4	.5731755	56 18 22.6	8 8.20	+4 1 6.4	+27.59	58 0.1	−2.6
12	14 47 54.9	.6166081	56 53 42.3	8 7.76	+4 3 5.3	+27.17	57 58.1	−2.6
12	15 36 57.2	.6506624	57 21 22.9	8 7.43	+4 4 37.2	+26.86	57 56.7	−2.6
Sept. 2	6 54 7.8	.2875903	319 2 44.4	8 55.80	−3 43 43.2	+34.40	60 36.5	+3.2
8	8 4 2.0	.3361343	49 5 17.4	8 28.70	+3 43 16.9	+33.13	59 12.7	−2.5
Oct. 5	12 47 34.5	.5330387	46 14 53.2	8 48.68	+3 33 3.7	+36.22	60 16.1	−2.3
25	7 4 51.8	.2950440	294 43 29.0	8 1.80	−4 53 21.0	+15.60	57 33.5	+5.6
25	7 8 16.7	.2974155	294 45 24.4	8 1.80	−4 53 17.3	+15.63	57 33.6	+5.6
Nov. 3	6 49 41.5	.2845081	65 14 53.2	8 41.33	+4 33 39.8	+22.39	59 43.6	−1.9
27	4 49 27.6	.2010138	13 43 51.7	8 42.20	+1 1 5.6	+45.50	60 1.2	+2.9
29	9 43 9.2	.4049674	45 56 36.6	8 47.15	+3 30 42.7	+33.53	60 5.4	+0.9
Dec. 26	5 7 59.5	.2138831	38 28 43.2	8 31.20	+3 11 11.5	+34.60	59 17.6	+2.4
26	5 8 12.6	.2140347	38 28 52.7	8 31.13	+3 11 12.1	+34.61	59 17.6	+2.4
1839, Apr. 20	15 28 40.7	.6449155	125 34 22.0	7 39.68	+3 55 39.8	−27.45	56 19.3	+0.4
May 2	12 41 25.9	.5287720	268 49 25.4	7 26.46	−5 6 14.5	+ 3.47	55 16.2	+2.5
6	13 16 34.7	.5524848	320 44 18.9	8 6.93	−2 47 0.4	+36.67	58 0.4	+2.1
24	4 2 2.6	.1680857	201 10 39.8	7 4.67	−2 25 41.5	−32.94	54 2.8	...
24	4 18 3.2	.1792035	201 18 32.0	7 4.66	−2 26 18.0	−32.86	54 2.7	...
June 19	13 0 27.4	.5419838	190 18 7.0	7 6.98	−1 46 27.9	−35.26	54 21.1	+2.2
20	13 7 31.2	.5468889	202 11 36.6	7 5.28	−2 42 39.1	−31.55	54 11.3	+2.6
20	13 54 30.9	.5795243	202 34 44.7	7 5.32	−2 44 22.0	−31.42	54 11.1	+2.6
23	13 50 0.0	.5763889	238 18 35.6	7 16.30	−4 41 5.3	−13.62	54 36.2	+3.9
24	6 49 34.6	.2844283	246 56 16.2	7 21.09	−4 54 3.2	− 8.21	54 51.4	+3.8
July 1	18 42 7.9	.7792581	344 32 13.0	8 14.19	−0 19 48.0	+43.76	58 24.9	+3.0
1	19 54 49.6	.8297407	345 13 48.1	8 14.50	−0 16 7.1	+43.80	58 26.2	+3.0
6	21 13 51.2	.8846203	56 46 5.4	8 40.42	+4 43 3.8	+16.59	59 41.8	−2.2
6	21 41 43.2	.9039722	57 2 52.6	8 40.46	+4 43 35.8	+16.45	59 41.8	−2.2
23	8 50 33.8	.3684468	268 44 29.3	7 35.90	−5 1 3.1	+ 8.30	55 47.4	+4.4
Aug. 17	8 58 55.2	.3742504	239 51 40.5	7 11.60	−5 2 30.2	−11.04	54 29.4	+3.9
17	9 31 9.1	.3966336	240 7 46.9	7 11.69	−5 2 54.6	−10.84	54 29.9	+3.9
25	8 32 4.4	.3556065	344 31 51.2	8 35.10	−0 7 28.3	+47.50	59 30.1	+1.5
Sept. 11	11 26 31.2	.4767500	213 31 59.2	7 7.07	−3 54 35.2	−26.42	54 8.8	+1.8
26	9 8 29.8	.3809004	52 53 18.1	8 50.12	+4 50 36.6	+18.78	60 17.0	−2.3
26	15 0 0.0	.6250000	56 28 32.3	8 47.87	+4 57 42.0	+15.90	60 9.8	−2.3
26	16 12 0.0	.6750000	57 12 31.4	8 47.40	+4 59 0.1	+15.35	60 8.2	−2.3
26	17 24 0.0	.7250000	57 56 27.6	8 46.98	+5 0 15.4	+14.74	60 6.6	−2.3
Oct. 17	13 26 21.2	.5599676	321 31 59.7	8 5.37	−2 5 34.6	+40.26	57 55.4	+4.1
18	10 55 56.9	.4555197	333 47 36.9	8 20.46	−1 2 9.3	+44.46	58 48.0	+3.4
18	10 59 11.6	.4577731	333 49 28.7	8 20.40	−1 1 59.4	+44.40	58 48.2	+3.4
19	5 19 59.9	.2222210	344 35 23.9	8 33.50	−0 3 53.8	+46.50	59 31.6	+2.7

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1839, Oct. 19	8 41 40.6	.3622754	346 35 30.9	8 35.80	+0 6 58.6	+46.70	59 39.2	+2.7
28	19 16 32.2	.8031504	124 49 58.7	7 56.16	+3 17 36.3	−32.71	57 21.5	−3.3
Nov. 14	7 11 58.5	.2999827	326 48 56.1	7 55.30	−1 25 46.8	+40.40	57 23.3	+4.5
19	20 37 22.9	.8592928	46 52 10.9	9 12.04	+4 30 50.3	+21.01	61 26.3	−1.0
20	11 0 0.0	.4580000	56 3 55.0	9 12.91	+4 48 18.3	+13.73	61 27.5	−0.8
20	12 12 0.0	.5083333	56 49 59.8	9 12.89	+4 49 25.9	+13.20	61 25.1	−0.8
20	13 24 0.0	.5583333	57 36 4.4	9 12.80	+4 50 30.2	+12.50	61 26.9	−0.8
Dec. 12	6 44 41.2	.2810324	336 14 8.6	7 53.40	−0 20 7.4	+41.70	57 50.0	+4.6
12	13 23 20.9	.5578808	339 53 20.9	7 56.68	−0 0 48.4	+42.02	57 27.0	+4.6
12	14 33 22.0	.6065047	340 32 0.0	7 57.24	+0 2 36.2	+42.08	57 29.2	+4.6
1840, Jan. 11	3 35 11.8	.1494421	11 48 0.4	8 15.95	+2 54 8.5	+36.78	58 30.5	+3.7
11	4 42 6.1	.1959039	12 26 25.7	8 16.30	+2 56 59.0	+36.53	58 32.0	+3.7
13	7 34 59.3	.3159641	42 15 29.9	8 35.90	+4 39 22.6	+19.66	59 32.1	+2.6
13	7 51 34.1	.3274781	42 25 22.2	8 36.00	+4 39 45.2	+19.50	59 32.4	+2.6
13	8 29 35.2	.3538796	42 48 6.7	8 36.22	+4 40 36.5	+19.23	59 33.0	+2.6
14	8 52 32.4	.3698194	57 28 49.3	8 43.60	+5 4 1.3	+ 8.03	59 53.6	+2.6
14	9 5 55.4	.3791134	57 36 54.9	8 43.70	+5 4 8.8	+ 8.00	59 53.8	+2.6
14	9 23 29.6	.3913148	57 47 33.9	8 43.70	+5 4 18.5	+ 7.80	59 54.0	+2.6
14	9 29 23.6	.3954120	57 51 8.4	8 43.70	+5 4 21.7	+ 7.80	59 54.1	+2.6
14	9 51 42.8	.4109120	58 4 41.5	8 43.80	+5 4 33.6	+ 7.55	59 54.3	+2.6
14	10 1 14.4	.4175277	58 10 26.9	8 43.80	+5 4 38.7	+ 7.50	59 54.4	+2.6
16	6 10 11.1	.2570730	85 7 16.5	8 45.55	+4 53 57.3	−14.43	60 5.6	+0.8
16	6 11 2.8	.2576713	85 7 47.4	8 48.60	+4 53 56.4	−14.40	60 5.6	+0.8
16	7 50 59.3	.3270753	86 8 56.6	8 48.46	+4 52 13.0	−15.21	60 5.2	+0.8
20	14 17 14.0	.5953010	146 56 14.7	8 7.28	+0 54 2.6	−43.51	57 53.7	−0.6
Feb. 15	10 33 2.6	.4396134	125 38 4.6	8 19.03	+2 42 38.5	−39.42	58 29.2	+0.8
15	11 13 0.9	.4673715	126 1 9.6	8 18.82	+2 40 49.0	−39.58	58 28.5	+0.8
26	11 13 26.1	.4676632	264 3 16.9	7 12.97	−5 2 24.1	+11.98	54 33.7	+3.4
Mar. 15	7 26 38.9	.3101725	146 51 33.5	7 55.58	+0 53 12.6	−43.11	57 10.2	+1.4
15	8 34 3.6	.3569862	147 28 39.2	7 55.20	+0 49 50.6	−43.14	57 8.9	+1.4
23	8 13 2.0	.3423843	246 38 30.4	7 7.54	−5 13 5.3	+ 0.27	54 9.4	+3.1
23	9 7 12.6	.3800070	247 5 18.5	7 7.41	−5 13 3.6	+ 0.60	54 9.5	+3.1
Apr. 11	9 58 16.6	.4144700	145 4 15.5	7 50.22	+0 57 12.4	−41.64	56 58.7	+1.2
11	10 5 23.8	.4204144	145 8 6.9	7 50.20	+0 56 51.8	−41.60	56 58.4	+1.2
13	7 46 50.1	.3241910	169 35 28.8	7 35.35	−1 14 7.3	−39.71	55 57.5	+1.6
16	8 17 2.2	.3451643	207 3 10.3	7 18.55	−3 59 57.0	−24.10	54 42.3	+2.7
19	20 20 41.4	.8477013	249 4 58.0	7 7.39	−5 3 57.4	+ 2.75	54 2.5	+3.5
19	21 13 21.2	.8842731	249 31 1.0	7 7.36	−5 3 46.7	+ 3.92	54 2.5	+3.5
May 6	14 4 23.2	.5863796	117 3 44.0	8 24.35	+3 0 13.2	−35.70	59 0.0	+0.7
8	8 30 56.6	.3548217	141 10 52.2	7 58.16	+1 4 42.4	−41.31	57 32.4	+1.2
9	9 17 3.5	.3868461	154 41 57.0	7 45.34	−0 6 28.8	−41.11	56 45.0	+1.0
18	10 40 12.0	.4445834	264 53 47.2	7 7.54	−4 36 38.0	+14.38	54 1.7	+3.2
19	11 52 48.0	.4950001	277 23 16.5	7 8.97	−4 4 58.7	+21.66	54 12.8	+3.4
19	13 29 41.7	.5622883	278 11 23.6	7 9.13	−4 2 31.4	+22.13	54 13.8	+3.4
20	10 37 13.6	.4425186	288 42 51.1	7 11.91	−3 25 59.6	+27.58	54 29.6	+3.2
20	12 1 46.0	.5012269	289 25 7.7	7 12.15	−3 23 16.8	+27.92	54 30.8	+3.2
22	13 59 14.8	.5828102	314 45 29.3	7 26.07	−1 28 16.2	+37.55	55 33.5	+3.0
22	15 20 35.2	.6392963	315 27 30.6	7 26.58	−1 24 43.5	+37.75	55 35.7	+3.0
June 12	14 18 5.5	.5958970	239 59 1.2	7 7.57	−5 1 37.6	+ 0.01	53 59.0	+3.4
July 10	15 3 11.8	.6272198	249 6 42.0	7 7.23	−5 3 36.1	+ 7.30	54 2.4	+3.8
10	15 52 27.7	.6614317	249 31 3.5	7 7.28	−5 3 10.6	+ 7.57	54 2.3	+3.8
Sept. 3	5 57 10.8	.2480417	249 6 16.5	7 8.60	−5 9 22.2	+ 8.00	54 17.7	+3.1
8	18 47 29.2	.7829769	316 1 44.0	7 34.23	−1 2 11.5	+40.91	55 53.5	+3.6
Oct. 6	13 43 10.0	.5716436	321 12 50.1	7 34.50	−0 28 17.8	+40.75	56 1.5	+3.9
13	12 15 53.8	.5110395	57 19 1.0	8 46.84	+5 5 5.6	− 1.18	59 59.6	−1.1
Nov. 2	11 24 1.3	.4750152	315 27 1.8	7 20.08	−0 45 14.3	+38.45	55 14.1	+4.0
2	12 46 54.4	.5325743	316 9 16.5	7 20.73	−0 41 32.5	+38.59	55 16.3	+4.0
3	12 12 43.7	.5088391	328 15 3.7	7 31.96	+0 22 27.2	+39.80	55 57.4	+3.9
1841, Feb. 7	7 2 50.5	.2936401	162 5 23.0	8 35.35	−2 9 35.1	−43.50	59 31.6	−0.2
27	6 38 5.5	.2764526	55 22 21.9	8 17.10	+5 12 30.8	− 5.90	58 24.5	+3.8
Apr. 28	8 23 35.2	.3497129	134 32 25.5	8 22.70	−0 1 57.2	−44.40	58 58.0	+2.1
May 23	8 49 32.4	.3677361	102 15 29.3	8 50.28	+2 28 12.8	−40.86	60 23.8	+2.0
June 4	14 14 16.7	.5932489	264 39 49.0	7 13.53	−3 38 56.0	+26.82	54 25.6	+3.4
30	10 51 47.2	.4526296	247 46 49.3	7 17.92	−4 34 51.2	+18.89	54 42.9	+3.9
July 28	16 51 1.1	.7020961	259 55 54.3	7 11.53	−4 0 20.5	+25.98	54 25.7	+4.0
Aug. 1	21 6 52.5	.8797743	309 24 26.2	7 5.79	+0 2 5.1	+39.46	54 3.0	+3.9
10	10 30 0.0	.4375000	56 32 14.5	8 13.81	+5 2 37.6	−13.61	58 15.5	+0.7
10	11 42 0.0	.4875000	57 13 25.0	8 14.50	+5 1 27.8	−14.21	58 18.0	+0.7
10	12 54 0.0	.5375000	57 54 39.0	8 15.13	+5 0 15.4	−14.70	58 20.5	+0.7
Sept. 6	16 0 0.0	.6666667	56 14 35.2	8 4.54	+4 56 47.6	−13.38	57 40.5	+0.2

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1841, Sept. 6	17 12 0.0	.7166667	56 54 59.0	8 5.03	+4 55 39.4	−13.80	57 21.8	+0.2
6	18 24 0.0	.7666667	57 35 25.0	8 5.44	+4 54 28.8	−14.34	57 44.2	+0.2
22	6 49 31.0	.2843866	271 59 27.3	7 11.50	−3 0 24.9	+31.40	54 37.3	+3.9
25	12 0 18.8	.5002177	310 3 47.3	7 6.10	+0 12 32.9	+38.19	54 14.6	+4.7
Oct. 6	21 47 4.3	.9076888	97 45 12.6	8 23.31	+2 26 36.8	−39.05	58 56.9	−1.2
Nov. 27	14 1 14.5	.5841956	56 36 2.2	8 27.11	+4 36 28.1	−19.05	58 49.8	+1.7
27	14 44 35.7	.6143021	57 1 29.6	8 27.51	+4 35 30.0	−19.41	58 51.0	+1.7
1842, Jan. 17	14 21 22.5	.5981771	7 22 51.1	7 18.60	+4 53 59.5	+15.11	54 55.7	...
21	10 48 9.0	.4501042	56 41 29.6	8 8.40	+4 44 3.2	−20.22	57 57.9	+4.1
21	11 40 28.0	.4864352	57 11 5.4	8 9.00	+4 42 48.7	−20.59	58 0.0	+4.1
24	13 57 1.1	.5812628	101 21 44.0	8 56.40	+1 41 19.7	−47.09	60 44.9	+1.6
Mar. 22	8 18 36.1	.3462512	129 54 12.0	8 45.10	−1 4 8.9	−45.70	60 12.2	+3.0
22	8 26 52.2	.3519930	129 59 13.6	8 45.20	−1 4 35.2	−45.60	60 12.4	+3.0
Apr. 12	12 1 47.5	.5012442	46 55 9.4	7 46.05	+4 39 21.6	−14.89	56 23.4	+3.7
May 14	7 46 47.8	.3241644	108 25 15.3	8 21.50	+0 20 58.0	−44.70	58 49.1	+3.2
June 12	7 32 20.6	.3141273	132 50 48.4	8 36.90	−1 57 0.3	−43.80	59 40.7	+2.7
Oct. 7	18 35 6.2	.7743773	248 42 56.5	8 9.49	−3 3 50.0	+34.12	58 5.0	...
1843, Jan. 24	22 50 57.3	.9520521	245 21 6.3	8 0.61	−3 5 54.4	+35.55	57 32.2	−1.1
Mar. 6	7 41 15.7	.3203206	46 19 46.0	7 13.50	+4 0 44.4	−23.20	54 37.1	+3.5
Apr. 2	12 16 2.9	.5111446	45 38 35.2	7 12.96	+3 51 16.8	−24.10	54 27.0	+3.8
May 3	6 33 8.0	.2730093	89 4 16.3	7 35.70	+0 22 32.1	−40.80	56 3.3	+3.5
3	9 5 1.2	.3784861	90 24 28.3	7 36.60	+0 15 21.0	−40.90	56 6.8	+3.5
3	9 19 38.5	.3886401	90 32 12.0	7 36.70	+0 14 39.5	−41.00	56 7.1	+3.5
9	9 14 46.4	.3852592	172 2 47.6	8 46.00	−5 2 49.1	− 9.00	60 3.0	+2.6
June 3	8 54 58.4	.3715092	140 5 32.5	8 12.90	−3 53 41.4	−30.30	58 13.6	+2.9
Sept. 11	12 44 17.9	.5307627	24 18 44.7	7 6.67	+4 30 40.0	−16.18	54 1.5	−0.1
30	13 51 17.4	.5772847	283 11 26.5	7 53.66	+1 25 17.8	+40.08	57 15.9	+2.8
Oct. 6	10 38 4.5	.4431077	356 16 8.0	7 12.40	+5 0 46.8	− 0.08	54 16.0	+2.1
Nov. 2	4 57 20.8	.2064908	350 27 28.5	7 12.60	+5 7 42.4	+ 2.50	54 25.5	+2.3
2	5 1 8.8	.2091297	350 29 22.7	7 12.60	+5 7 43.1	+ 2.50	54 25.4	+2.3
3	13 22 15.5	.5571239	6 36 3.8	7 8.40	+5 0 57.9	− 8.37	54 5.4	+2.4
27	8 6 49.7	.3380751	323 55 42.2	7 36.75	+4 35 51.4	+20.40	56 5.8	+1.8
1844, Jan. 8	9 43 32.7	.4052395	146 27 15.5	8 8.22	−4 41 10.7	−19.79	57 46.5	−1.2
8	10 57 54.3	.4568796	147 9 17.4	8 8.53	−4 42 51.5	−19.31	57 47.8	−1.2
Feb. 22	11 57 51.1	.4985081	26 29 1.4	7 10.27	+4 2 46.3	−22.55	54 22.2	+1.7
Apr. 26	9 39 20.3	.4023183	139 25 3.4	7 55.90	−4 42 35.9	−18.20	57 14.0	+2.4
May 23	14 35 0.0	.6076389	138 20 40.1	7 43.70	−4 46 32.3	−18.38	56 28.7	+2.3
Nov. 24	11 34 54.5	.4825753	62 47 58.0	7 5.27	+0 11 19.2	−39.43	54 0.1	+1.6
24	12 41 3.4	.5285116	63 20 31.3	7 5.18	+0 8 18.0	−39.42	53 59.9	+1.6
Dec. 14	14 12 52.2	.5922708	334 29 50.2	8 5.75	+5 16 27.8	+ 0.20	57 44.7	+2.1
1845, Jan. 12	4 58 25.0	.2072338	351 6 30.0	8 1.20	+4 54 20.1	−12.90	57 29.0	+2.1
12	5 3 0.4	.2104213	351 9 3.3	8 1.20	+4 54 15.9	−12.90	57 28.8	+2.1
Mar. 22	12 58 45.8	.5408079	172 7 52.0	8 4.88	−4 36 54.1	+18.15	57 30.4	+1.3
Apr. 12	9 20 41.4	.3893680	91 0 8.5	7 5.20	−2 59 54.3	−31.70	54 11.4	+1.8
May 16	7 28 58.1	.3117836	171 50 29.6	7 52.64	−4 45 16.8	+19.13	57 0.3	+2.5
16	8 20 20.9	.3474641	172 18 37.2	7 53.22	−4 44 7.8	+19.48	57 2.2	+2.5
20	8 23 56.8	.3499629	228 17 1.8	8 50.64	−0 41 0.4	+48.71	60 25.3	+1.5
20	8 29 53.7	.3540937	228 20 40.8	8 50.80	−0 40 40.3	+48.70	60 25.5	+1.5
June 16	11 35 1.1	.4826516	223 51 49.4	8 38.52	−1 2 59.7	+46.47	59 49.0	+2.0
July 16	14 18 31.6	.5961991	263 38 0.9	8 59.78	+2 31 33.2	+41.61	60 55.8	+1.7
17	14 56 0.1	.6222234	279 8 15.8	9 7.25	+3 36 46.2	+33.97	61 15.3	+1.2
Sept. 13	8 54 58.5	.3715104	323 17 46.6	8 44.20	+5 3 39.5	− 4.10	59 49.0	+2.3
22	16 10 52.3	.6742165	86 13 7.2	7 8.47	−3 12 52.5	−30.09	54 25.1	−1.8
22	21 8 16.7	.8807488	88 40 29.9	7 7.78	−3 23 3.7	−28.97	54 22.1	−1.8
Oct. 20	9 12 10.3	.3834525	90 34 24.8	7 10.18	−3 39 30.8	−28.37	54 26.8	−1.2
20	10 11 4.0	.4243518	91 3 43.9	7 10.02	−3 41 26.6	−28.13	54 26.2	−1.2
Nov. 6	6 57 48.5	.2901447	314 38 56.1	8 27.80	+5 17 10.1	+ 1.60	59 2.3	+2.5
6	6 58 43.6	.2907823	314 39 29.4	8 27.90	+5 17 10.2	+ 1.58	59 2.3	+2.5
6	7 33 53.5	.3152024	315 0 9.5	8 27.69	+5 17 13.7	+ 1.25	59 1.7	+2.5
9	9 20 3.9	.3889339	357 27 12.3	8 5.75	+4 0 12.1	−29.25	57 44.4	+2.6
9	9 27 18.1	.3939595	357 31 15.3	8 5.60	+3 59 57.5	−29.20	57 44.3	+2.6
9	10 29 29.5	.4371470	358 6 13.6	8 5.39	+3 57 50.0	−29.58	57 43.1	+2.6
10	10 27 36.6	.4358403	11 27 42.9	7 57.52	+3 2 50.3	−35.99	57 15.0	+2.4
Dec. 6	15 16 0.4	.6361158	357 44 6.5	8 3.81	+3 55 38.4	−29.15	57 44.5	+2.2
1846, Feb. 6	13 52 31.4	.5781313	91 9 44.5	7 8.29	−3 49 29.3	−24.18	54 13.5	+0.9
20	22 4 58.8	.9201251	271 11 52.6	8 38.20	+3 57 26.5	+28.40	59 42.6	+0.1
Mar. 31	15 27 39.9	.6442118	72 8 36.3	7 31.55	−2 59 19.0	−33.88	55 49.0	+1.6
May 3	13 38 33.9	.5684479	139 27 18.9	7 8.38	−5 9 44.6	+ 8.31	54 16.5	+2.0
4	10 0 12.2	.4168079	149 34 32.1	7 10.90	−4 53 10.0	+15.00	54 26.4	+2.0
June 29	13 11 29.0	.5496412	167 19 24.7	7 9.50	−3 45 12.9	+25.59	54 24.6	+1.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1846, July 5	9 18 34.8	.3879028	241 32 20.2	8 19.88	+2 16 43.4	+39.42	58 41.1	+1.2
Aug. 14	13 6 9.1	.5459387	64 44 59.7	7 35.22	−2 49 32.1	−33.40	56 5.2	−1.5
14	13 59 23.2	.5829075	65 13 1.9	7 34.80	−2 51 35.3	−33.15	56 3.6	−1.5
Sept. 14	12 2 51.7	.5019874	110 2 52.4	7 11.75	−5 7 16.9	− 5.85	54 26.1	−1.3
Nov. 22	4 44 11.9	.1973599	287 31 5.7	8 25.58	+5 7 2.8	+ 7.99	58 47.7	+1.5
1847, Apr. 25	7 50 50.1	.3269688	162 51 15.6	7 4.94	−3 6 15.3	+31.75	54 5.5	0.0
May 21	7 35 48.8	.3165371	147 8 30.0	7 11.62	−4 1 22.9	+24.64	54 34.0	...
June 17	7 2 40.3	.2935221	142 42 36.4	7 18.98	−4 3 41.1	+23.13	54 55.8	−0.9
Oct. 18	8 51 46.1	.3692836	314 26 42.5	8 22.02	+4 20 52.7	−26.25	58 47.6	+2.0
1848, Feb. 15	6 46 58.2	.2826180	106 9 56.5	7 56.50	−5 0 45.4	+11.20	57 3.9	+1.2
Mar. 28	16 12 6.6	.6750764	291 53 42.8	7 50.02	+4 55 59.6	−15.72	56 52.2	−0.4
Apr. 15	9 0 12.9	.3751493	176 19 1.4	7 9.48	−0 23 16.2	+39.36	54 20.9	+0.2
May 8	5 11 25.5	.2162674	121 17 4.0	7 58.35	−4 22 33.3	+22.62	57 24.1	+1.3
9	9 9 48.2	.3818079	136 28 21.6	7 40.30	−3 30 41.4	+30.20	56 23.0	+1.2
17	9 2 49.1	.3769572	232 35 24.8	7 9.86	+4 5 20.5	+22.60	54 9.7	−0.9
17	10 35 4.0	.4410186	233 21 19.4	7 10.09	+4 7 43.8	+22.17	54 10.4	...
June 8	9 24 15.6	.3918473	170 3 11.1	7 17.76	−0 36 29.7	+38.45	55 4.9	+0.6
Nov. 8	8 27 51.6	.3526806	15 18 27.7	8 53.10	−2 10 48.6	−42.97	60 34.5	+1.0
Dec. 4	6 3 18.7	.2522998	354 10 2.4	8 11.00	−0 36 17.7	−42.90	58 19.0	+2.8
1849, Jan. 3	4 56 39.2	.2060092	31 16 43.5	8 31.80	−3 43 36.2	−30.80	59 22.9	+3.1
3	6 2 53.4	.2520069	31 55 59.1	8 32.40	−3 45 57.6	−30.50	59 24.6	...
Feb. 13	11 26 45.1	.4769109	222 12 49.8	7 11.31	+4 33 36.1	+19.81	54 30.5	−2.3
13	12 38 58.6	.5270672	222 48 52.7	7 11.06	+4 35 14.5	+19.41	54 29.6	...
Apr. 5	7 4 30.3	.2947952	174 11 31.8	7 40.30	+1 6 17.5	+40.90	56 13.0	+0.8
6	8 39 25.5	.3607119	187 42 51.9	7 33.11	+2 15 46.6	+36.96	55 42.6	0.0
6	10 6 43.2	.4213334	188 28 37.6	7 32.77	+2 19 29.9	+36.65	55 40.9	...
July 13	12 54 24.8	.5377871	30 53 35.3	8 20.73	+4 20 23.5	−24.48	58 42.7	−1.1
13	13 23 56.1	.5582883	31 10 42.3	8 21.00	−4 21 13.6	−24.32	58 43.6	...
Sept. 25	8 23 49.2	.3498751	287 37 56.7	7 9.93	+3 42 15.8	−27.67	54 27.9	+0.2
25	9 24 18.4	.3918797	288 8 3.0	7 10.05	+3 40 19.0	−27.89	54 28.6	...
Oct. 3	7 57 35.7	.3316633	31 16 23.4	8 30.00	−4 25 11.7	−23.74	59 1.6	−0.4
25	5 54 42.1	.2463206	318 20 59.2	7 21.70	+1 7 33.5	−38.40	55 18.5	+0.5
Nov. 23	7 11 49.6	.2998797	339 25 23.0	7 31.01	−0 59 38.5	−39.01	55 54.7	+1.3
23	8 28 26.2	.3530810	340 5 24.3	7 31.66	−1 3 6.1	−38.98	55 57.2	...
26	11 2 34.2	.4601180	21 11 24.7	8 23.50	−4 1 50.2	−26.29	58 47.8	+1.3
Dec. 1	9 12 13.4	.3834885	94 19 18.3	9 4.88	−4 0 7.4	+28.88	61 5.8	−0.2
22	3 11 14.5	.1328068	358 32 34.9	7 39.38	−2 49 15.7	−34.38	56 22.4	...
1850, Jan. 17	7 55 1.0	.3298728	345 20 0.0	7 23.10	−1 55 36.7	−37.82	55 15.6	+1.9
23	8 13 39.2	.3428149	65 3 27.3	8 39.72	−5 9 41.2	+ 9.21	59 42.4	+3.7
25	7 37 24.6	.3176459	94 13 59.3	9 1.75	−4 0 43.9	+32.23	60 57.2	+3.0
25	8 54 30.4	.3711852	95 2 20.4	9 2.12	−3 57 50.0	+32.75	60 58.5	...
Feb. 21	7 25 41.1	.3095035	88 44 20.8	8 38.84	−4 20 18.5	+27.42	59 43.8	+4.4
21	7 41 25.2	.3204306	88 53 48.0	8 38.98	−4 19 48.5	+27.59	59 44.1	...
Apr. 15	5 51 38.0	.2441898	66 50 27.0	8 29.30	−4 53 3.4	+11.80	59 0.2	+2.2
15	8 5 59.0	.3374884	68 9 39.7	8 29.60	−4 51 7.9	+12.90	59 1.6	...
16	7 43 34.9	.3219317	82 7 24.3	8 31.20	−4 21 29.9	+23.00	59 13.0	+2.7
17	5 19 40.4	.2219954	94 54 26.8	8 31.15	−3 40 38.3	+31.14	59 18.0	+3.1
21	10 40 16.4	.4446342	154 20 58.1	8 20.70	+1 9 1.9	+43.20	58 45.7	+3.4
22	6 46 36.0	.2823611	165 57 44.9	8 17.30	+2 7 15.2	+39.90	58 29.7	+3.2
June 13	6 8 57.7	.2562234	130 21 12.1	8 47.02	−0 30 19.2	+47.06	60 18.7	+3.2
13	6 10 2.2	.2569711	130 21 51.5	8 47.05	−0 30 15.7	+47.06	60 18.6	...
July 30	12 18 9.5	.5126100	22 53 10.9	7 39.07	−4 55 7.8	−15.70	56 11.2	−1.6
Aug. 14	8 49 44.5	.3678762	233 7 50.5	7 37.10	+5 14 19.3	− 6.10	56 3.8	+1.1
31	15 2 50.7	.6269758	88 5 8.2	8 29.60	−3 48 50.2	+32.19	59 15.3	−0.3
Sept. 1	15 19 0.1	.6381969	102 33 52.7	8 41.02	−2 47 17.4	+40.52	59 56.3	+0.5
30	14 15 22.0	.5940048	126 18 19.4	8 37.39	−0 37 49.0	+46.03	59 46.7	0.0
Nov. 17	7 11 16.3	.2994944	31 20 59.6	7 57.56	−4 59 23.2	− 5.28	57 4.5	−0.2
1851, Jan. 15	5 46 15.0	.2404514	87 59 58.8	8 44.10	−3 13 52.7	+38.30	59 59.3	+1.3
Mar. 9	8 27 57.6	.3527500	65 48 37.9	7 50.56	−4 24 55.6	+21.97	56 55.1	+3.0
13	9 43 5.2	.4049213	121 41 20.6	8 43.80	−0 15 27.9	+47.20	60 9.0	+3.8
26	16 18 2.1	.6791910	304 51 46.9	7 5.52	−0 6 15.7	−37.98	54 15.1	−2.0
Apr. 18	13 42 25.8	.5711320	249 23 32.4	8 3.01	+3 56 39.8	−26.22	57 34.3	−0.2
May 17	15 20 30.7	.6392443	271 23 19.6	7 43.59	+2 17 47.5	−36.75	56 27.2	−0.4
17	16 14 25.9	.6766888	271 52 14.9	7 43.10	+2 15 29.7	−36.86	56 25.6	...
18	8 12 22.7	.3419296	280 21 5.4	7 34.71	+1 33 36.3	−38.54	55 58.3	−0.6
18	8 28 34.5	.3531773	280 29 36.9	7 34.66	+1 32 53.0	−38.56	55 57.9	...
18	9 2 59.1	.3770731	280 47 43.0	7 34.31	+1 31 20.8	−38.60	55 57.0	...
June 7	10 39 2.1	.4437745	182 1 23.6	8 28.68	+4 40 55.9	+19.42	59 6.0	+3.0
17	13 29 28.8	.5621402	315 35 12.6	7 12.54	−1 41 52.7	−37.41	54 36.5	−1.7
July 12	5 35 45.6	.2331668	283 10 14.7	7 30.23	+1 12 52.3	−40.50	55 34.2	−0.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0.d01.	Parallax.	δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1851, Aug. 2	8 13 59.8	.3430533	202 2 27.9	8 31.50	+5 15 29.8	+ 3.50	59 14.8	+2.9
8	7 24 45.2	.3088566	280 54 55.0	7 26.58	+1 24 49.8	−39.62	55 25.5	+0.6
8	8 51 19.9	.3689804	281 39 38.7	7 26.24	+1 20 51.3	−39.71	55 23.8	...
Sept. 4	8 59 21.8	.3745579	278 48 44.0	7 27.20	+1 29 45.6	−38.60	55 35.8	+0.8
Oct. 17	18 33 26.9	.7732280	117 37 43.8	8 11.49	+0 32 13.0	+43.08	58 20.3	...
Dec. 5	6 53 30.1	.2871540	39 37 33.0	7 25.90	−4 48 29.1	+15.00	55 12.0	−1.6
7	8 41 28.3	.3621331	65 50 55.6	7 44.17	−3 27 23.1	+31.45	56 19.7	−1.2
7	9 51 7.6	.4105046	66 28 21.7	7 44.56	−3 24 50.3	+31.75	56 21.4	...
31	7 24 32.9	.3087141	23 18 43.3	7 12.09	−5 15 10.8	+ 4.20	54 30.0	−1.4
1852, Jan. 4	3 23 28.1	.1412978	71 0 28.2	7 48.40	−3 7 42.8	+34.80	56 42.0	−0.7
6	5 45 44.8	.2401019	99 3 16.2	8 13.40	−0 45 12.1	+45.20	58 11.9	−0.4
Feb. 15	14 44 33.1	.6142731	281 52 48.3	7 39.58	+0 26 22.2	−41.54	56 16.8	−1.7
15	15 37 41.2	.6511712	282 21 3.7	7 39.31	+0 23 49.0	−41.52	56 15.6	...
Mar. 9	11 32 35.5	.4809663	222 23 40.9	8 44.72	+4 29 24.9	−21.43	60 1.5	−0.8
9	12 27 30.2	.5190995	222 57 0.7	8 44.11	+4 28 2.6	−21.75	59 59.7	...
30	8 44 53.1	.3645035	124 57 5.6	8 16.40	+1 53 40.3	+40.40	58 34.8	+3.0
30	9 19 3.5	.3882350	125 16 44.0	8 16.70	+1 55 16.2	+40.30	58 56.2	...
30	9 19 22.4	.3884537	125 16 54.8	8 16.70	+1 55 17.1	+40.30	58 36.2	...
30	9 40 15.2	.4029537	125 28 55.4	8 17.10	+1 56 15.5	+40.30	58 37.0	...
Apr. 25	6 42 30.7	.2795220	106 43 3.8	7 44.20	+0 35 42.4	+41.00	56 40.2	+2.1
27	9 30 42.9	.3963298	134 47 48.2	8 12.20	+2 54 22.1	+35.80	58 18.9	+3.2
28	10 21 3.0	.4312847	149 10 34.7	8 28.10	+3 51 4.9	+29.30	59 9.9	+3.5
Aug. 25	6 47 43.6	.2831435	287 8 49.0	7 53.90	−0 56 5.4	−41.60	57 8.2	+1.7
Sept. 18	6 2 33.6	.2517777	242 36 49.7	8 33.20	+2 38 3.9	−38.40	59 31.1	+2.5
Sept. 23	7 46 19.0	.3238310	310 31 39.7	7 36.40	−2 59 37.8	−32.10	56 2.1	+0.9
Oct. 23	6 27 1.2	.2687639	344 10 2.4	7 17.86	−4 51 16.7	−11.07	54 45.4	+0.1
24	5 24 19.6	.2252268	355 44 27.2	7 13.50	−5 2 47.3	− 3.40	54 24.9	−0.5
1853, Jan. 6	19 29 51.6	.8124028	255 40 10.6	8 41.73	+1 11 36.7	−46.86	59 54.7	...
6	20 48 35.2	.8670741	256 27 42.7	8 41.57	+1 7 20.2	−46.99	59 54.3	...
Feb. 18	5 22 39.3	.2240660	88 28 1.9	7 20.40	+0 9 17.7	+39.20	55 11.5	+0.4
Apr. 20	6 51 35.8	.2858310	171 8 23.6	8 35.07	+5 7 22.3	− 0.25	59 22.2	+2.3
May 12	7 34 39.4	.3157338	102 28 4.2	7 13.30	+2 1 58.3	+36.60	54 39.5	+0.4
20	9 0 31.5	.3753646	210 11 56.8	8 58.70	+3 59 55.2	−32.00	60 47.5	+2.8
July 17	9 24 38.3	.3921100	258 16 12.2	8 48.90	+0 5 0.1	−48.20	60 22.2	+3.1
Sept. 6	5 54 15.9	.2460173	206 10 23.7	8 29.05	+3 46 54.8	−29.38	59 4.8	+2.6
8	6 45 12.4	.2813935	235 0 58.8	8 30.09	+1 42 41.1	−42.26	59 20.2	+3.4
11	8 38 14.4	.3598889	278 25 14.1	8 24.25	−2 1 23.0	−40.71	58 59.3	+3.2
Nov. 7	8 54 36.5	.3712558	313 40 14.9	8 12.17	−4 40 28.4	−20.54	58 12.1	+1.8
Dec. 8	8 44 56.4	.3645417	2 52 36.9	7 35.79	−4 54 13.2	+15.99	55 59.9	−0.2
1854, Jan. 7	6 19 49.3	.2637651	35 22 5.5	7 15.80	−2 58 2.1	+32.60	54 52.8	−1.1
Mar. 3	5 58 17.9	.2488183	39 4 32.1	7 29.10	−2 12 8.2	+35.60	55 40.0	−1.3
7	7 4 41.3	.2949225	87 41 44.8	7 4.67	+1 57 55.4	+34.59	54 13.3	−0.7
20	11 18 35.1	.4712396	259 48 36.8	8 27.25	−1 26 22.5	−43.29	59 12.4	−0.5
22	12 19 8.2	.5132894	288 39 6.1	8 29.07	−3 37 1.5	−31.76	59 12.2	−0.7
22	13 14 53.5	.5520081	289 11 57.5	8 29.12	−3 39 3.9	−31.46	59 12.0	...
Apr. 13	9 21 55.2	.3902222	212 1 40.4	8 29.47	+2 34 20.9	−40.02	59 5.8	+0.5
13	10 28 28.6	.4364421	212 40 56.0	8 29.83	+2 31 15.3	−40.31	59 7.2	...
15	10 40 7.8	.4445347	241 24 56.8	8 38.45	+0 1 31.6	−47.14	59 44.6	−0.1
May 11	5 4 23.0	.2113773	217 54 4.9	8 38.02	+2 6 11.5	−43.95	59 39.2	+1.3
11	12 44 12.0	.5306944	222 30 42.6	8 41.44	+1 42 23.1	−45.59	59 51.5	...
22	17 9 2.7	.7146157	20 8 6.2	7 37.54	−3 29 27.7	+31.81	56 2.9	−2.8
June 7	5 27 4.6	.2271365	212 1 28.3	8 25.32	+2 35 5.7	−40.60	59 0.4	+2.4
7	6 23 25.5	.2662673	212 34 26.7	8 25.87	+2 32 26.3	−40.82	59 2.6	...
14	9 38 13.6	.4015462	318 26 31.9	8 42.23	−5 7 8.2	−10.47	59 50.7	−2.0
14	10 32 32.3	.4392626	318 59 20.9	8 41.83	−5 7 46.9	−10.00	58 48.9	...
July 5	8 44 59.2	.3645741	222 31 53.5	8 22.32	+1 36 12.8	−43.19	58 55.5	+2.9
7	9 44 39.0	.4060069	251 55 6.4	8 53.10	−1 1 3.9	−47.10	60 37.2	+2.3
13	13 26 33.8	.5601135	344 8 52.7	8 31.25	−4 58 2.0	+11.14	59 13.2	−2.3
13	14 35 0.3	.6076425	344 49 20.8	8 30.44	−4 57 7.9	+11.67	59 10.6	...
29	5 17 13.1	.2202606	177 37 45.8	7 31.30	+4 25 7.1	−19.22	55 38.5	+1.6
July 31	8 11 47.9	.3415266	204 45 24.6	7 50.80	+2 48 50.3	−34.60	57 1.0	+3.1
Aug. 8	5 43 36.1	.2386124	318 23 33.6	9 2.79	−4 56 50.5	− 7.85	60 52.5	+0.2
8	6 43 3.6	.2799029	319 0 54.6	9 2.52	−4 57 21.9	− 7.34	60 51.6	...
14	13 2 56.9	.5437142	45 44 54.6	7 29.43	−1 0 53.2	+38.87	55 48.4	...
14	14 12 44.1	.5921772	46 21 11.5	7 28.83	−0 57 44.8	+38.91	55 46.3	...
Sept. 1	9 10 10.0	.3820603	270 22 55.2	8 35.34	−2 53 5.4	−37.26	59 36.8	+3.1
2	8 34 38.4	.3573890	284 28 21.2	8 44.50	−3 48 15.3	−30.15	60 2.6	+2.7
2	10 17 6.6	.4285487	285 30 35.7	8 45.06	−3 51 48.1	−29.61	60 4.2	...
30	6 46 0.7	.2819525	293 51 54.3	8 34.20	−4 29 12.4	−22.50	59 26.4	+2.9
30	8 22 44.3	.3491239	294 49 29.4	8 34.50	−4 31 41.7	−21.80	59 27.0	...

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	$\varDelta v$.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1854, Oct. 29	7 47 20.7	.3245452	319 38 15.9	8 28.07	−5 15 22.6	− 2.20	59 1.6	+2.0
Nov. 27	8 15 29.5	.3440915	344 45 39.2	8 16.71	−4 52 18.2	+17.49	58 25.5	+0.9
27	9 21 29.1	.3899202	345 23 34.7	8 16.28	−4 50 57.0	+17.95	58 24.1	...
1855, Jan. 3	10 30 7.2	.4375845	109 30 49.9	7 8.88	+4 20 29.7	+19.83	54 4.5	−2.8
Apr. 4	11 28 30.8	.4781343	222 40 55.1	7 49.39	+0 1 35.5	−42.87	56 47.9	−1.1
4	12 40 18.0	.5279862	223 19 55.8	7 49.72	−0 1 58.3	−42.90	56 49.4	...
4	12 50 56.7	.5353797	223 25 43.2	7 49.81	−0 2 30.0	−42.91	56 49.6	...
8	12 39 21.4	.5273311	277 13 52.9	8 21.00	−4 15 6.1	−26.70	58 42.4	−1.3
8	13 41 13.0	.5702894	277 49 45.7	8 21.30	−4 17 0.1	−26.35	58 43.5	...
May 8	14 0 34.5	.5837326	317 17 55.9	8 32.57	−5 15 43.5	+ 3.65	59 17.7	−2.3
1856, Apr. 25	14 9 24.7	.5898692	282 17 44.4	5 57.55	−5 9 41.1	− 9.11	57 13.9	−1.8
25	15 39 35.3	.6524919	283 7 37.1	7 58.22	−5 10 36.5	− 8.50	57 16.3	...
Sept. 8	7 54 27.4	.3294838	270 0 50.7	7 47.25	−5 2 14.5	−11.55	56 41.4	+1.1
Nov. 12	7 42 45.3	.3213576	56 56 22.1	8 57.67	+3 28 20.2	+36.24	60 42.1	...
12	8 47 26.3	.3662766	57 36 36.6	8 57.30	+3 31 2.0	+35.79	60 40.9	...
1857, Jan. 15	12 44 58.8	.5312361	182 24 11.0	7 11.03	+0 35 16.4	−37.94	54 37.1	−4.0
15	13 37 57.2	.5680231	182 50 36.3	7 10.89	+0 32 56.8	−37.96	54 36.3	...
Feb. 6	11 3 0.1	.4604178	113 29 57.0	8 1.73	+4 54 39.1	−11.88	57 18.7	−2.3
Mar 16	11 3 51.2	.4610092	244 57 29.5	7 10.49	−4 31 28.7	−20.57	54 26.0	−1.4
16	12 3 30.7	.5024386	245 27 13.2	7 10.68	−4 32 53.2	−20.32	54 26.8	...
16	16 44 14.6	.4482303	247 47 20.4	7 11.73	−4 39 15.5	−18.94	54 30.9	...
18	10 34 59.5	.4409664	269 1 18.0	7 26.42	−5 14 55.7	− 5.14	55 24.6	−1.0
18	10 45 27.1	.6973912	269 6 42.3	7 26.51	−5 14 59.4	− 5.08	55 24.9	...
19	11 42 34.9	.4879039	282 10 48.1	7 38.96	−5 15 44.8	+ 4.34	56 10.3	−0.9
31	8 7 39.1	.3386470	91 50 42.6	8 17.12	+5 16 37.4	+ 3.44	58 26.3	−1.7
Apr. 29	5 17 0.0	.2201389	113 23 39.2	8 8.43	+4 58 0.2	−13.47	57 57.3	−1.7
May 31	10 14 0.6	.4263958	175 52 51.6	7 14.90	+0 42 58.1	−38.34	54 53.1	−0.7
July 27	6 11 58.6	.2583171	202 14 38.1	7 10.83	−2 3 38.3	−35.36	54 36.0	−0.8
Nov. 23	5 48 5.4	.2417291	319 45 53.2	7 35.65	−2 53 11.8	+33.11	56 7.2	+2.3
23	6 57 31.1	.2899432	320 22 31.1	7 36.17	−2 50 31.4	+33.40	56 9.3	...
1858, Mar. 6	9 54 31.3	.4128622	246 52 36.7	7 8.04	−5 11 15.8	− 7.45	54 15.3	−0.8
6	10 48 45.0	.4505208	247 19 28.5	7 8.00	−5 11 43.1	− 7.10	54 15.1	...
Oct. 12	8 58 12.9	.3737604	265 48 24.7	7 9.05	−4 54 25.5	+11.93	54 17.8	0.0

Since the right ascension and declination of the moon, based on Hansen's tables, are available from 1847 on, the direct computation from Hansen is unnecessary after that date, α and δ being interpolated from the Nautical Almanac. The reduction to the provisional theory for all dates not already given is found in the table following, which is a continuation of the last column of the preceding table. In cases where several occultations have been observed on the same day, $\varDelta v$ was generally computed for the mean of the times.

Date.	$\varDelta v$.	Date.	$\varDelta v$.	Date.	$\varDelta v$.	Date.	$\varDelta v$.
	″		″		″		″
1847, Jan. 3	−0.6	1848, June 6	+0.5	1849, Sept. 8	−0.2	1850, Oct. 14	−0.7
5	−1.1	13	−0.2	27	+0.4	21	−0.8
25	+1.2	July 11	+1.2	Nov. 22	+1.1	Nov. 21	−0.5
Feb. 24	+0.6	15	−0.9	29	+0.1	Dec. 17	+0.4
Mar. 24	+0.8	Aug. 7	−0.7	1850, Feb. 26	+1.8	1851, Apr. 6	+2.4
26	+0.1	21	−2.7	Mar. 23	+3.6	7	+2.0
Apr. 22	+0.6	Sept. 15	−2.0	24	+3.5	July 21	−2.0
May 23	−0.2	Oct. 28	−1.3	Apr. 18	+3.3	Sept. 14	−2.7
28	−0.5	Nov. 9	+0.5	May 19	+3.1	Oct. 2	+0.1
June 1	−1.3	1849, Feb. 9	−0.7	28	−2.1	11	−2.1
Sept. 16	+0.4	27	+2.2	June 1	−2.2	28	−0.1
Nov. 18	+1.6	Mar. 2	+2.9	14	+3.4	Dec. 10	−1.2
1848, Jan. 12	+2.1	3	+2.8	July 21	−0.8	1852, Feb. 3	+0.7
16	+2.2	8	+0.2	24	−2.2	11	−1.2
Feb. 12	+1.6	11	−1.1	Aug. 2	−0.5	May 2	+2.1
Mar. 11	+1.4	29	+2.4	8	+1.8	July 4	−2.1
21	−1.5	May 2	+1.0	27	−1.4	Aug. 26	+0.6
Apr. 12	+0.8	July 12	−2.3	30	−0.9	1853, Jan. 14	−0.8
May 4	+0.8	16	+1.5	Sept. 12	−0.3	Feb. 17	+0.4
7	+1.2	Sept. 5	−1.2	Oct. 13	−0.7	Mar. 26	+0.5

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1853, Mar. 28	−0.1	1859, Nov. 11	−4.4	1863, May 4	−6.8	1866, Aug. 29	−9.3
May 22	+2.0	Dec. 8	−1.1	June 28	−4.3	Sept. 15	−4.1
Aug. 29	−2.2	21	−2.8	30	−5.0	28	−9.4
Sept. 20	−3.0	1860, Jan. 4	−1.1	July 28	−4.4	29	−9.1
Oct. 14	+0.3	6	−3.1	Aug. 7	−4.7	Nov. 16	−4.1
Dec. 9	−0.1	Feb. 13	−5.1	27	−6.6	20	−5.1
1854, Feb. 7	−1.1	28	−0.1	30	−4.6	27	−8.4
9	−0.9	Mar. 1	−0.7	Sept. 24	−3.6	Dec. 24	−7.4
Mar. 12	+0.2	4	−2.1	Oct. 22	−3.1	1867, Jan. 29	−7.0
Apr. 4	−0.4	5	−2.8	23	−2.6	Apr. 8	−4.6
May 6	+1.4	7	−3.7	30	−4.1	16	−5.2
9	+2.0	12	−3.9	Nov. 3	−5.4	18	−6.0
June 28	−0.1	28	−1.1	17	−3.3	May 5	−5.3
Sept. 4	+1.6	Apr. 27	−2.2	19	−2.5	June 14	−5.5
19	−0.8	May 1	−2.7	30	−4.5	July 9	−5.5
Oct. 11	−3.3	8	−2.3	Dec. 19	−2.1	Oct. 16	−8.3
Dec. 10	−1.9	25	−2.5	24	−1.5	Nov. 6	−5.3
1855, Mar. 23	−2.2	June 1	−2.4	27	−3.7	8	−5.5
Apr. 7	−1.2	3	−2.3	30	−5.5	Dec. 28	−6.1
23	−1.9	Aug. 24	−0.7	1864, Jan. 24	−2.9	1868, Feb. 8	−6.3
June 27	+0.8	30	+0.9	Feb. 13	−2.7	11	−8.2
Aug. 30	−3.4	Sept. 6	−2.8	14	−2.5	28	−4.4
Sept. 20	+2.3	Oct. 17	−3.1	16	−2.1	29	−3.8
21	+2.0	Nov. 5	−5.4	25	−6.3	Mar. 1	−3.9
Oct. 24	+1.0	Dec. 19	+1.3	29	−7.3	28	−4.1
Nov. 15	+2.2	1861, Mar. 19	+0.4	Mar. 18	−2.8	Apr. 4	−5.5
1856, Jan. 12	−0.2	Apr. 19	−1.7	19	−3.2	May 4	−5.7
Mar. 11	−1.4	27	−3.6	24	−6.4	22	−5.5
13	−1.7	May 19	−2.7	27	−8.0	27	−4.4
26	−1.5	June 11	−2.4	Apr. 11	−2.3	June 24	−5.5
June 16	−0.3	25	−1.8	20	−5.5	July 1	−5.8
July 25	−4.7	Sept. 14	0.0	23	−8.1	Aug. 9	−7.0
Sept. 20	−5.9	26	−4.1	27	−8.3	Sept. 4	−6.6
Nov. 11	−1.7	Oct. 15	+0.6	May 20	−6.3	6	−7.0
1857, Mar. 4	−1.8	19	−0.6	June 20	−7.6	7	−7.4
Apr. 2	−1.7	20	−1.2	26	−7.4	8	−7.4
May 6	0.0	22	−2.6	July 18	−6.5	9	−7.2
27	+0.7	Dec. 23	−5.5	23	−7.3	28	−5.9
Sept. 29	−1.0	1862, Feb. 4	+0.8	Aug. 12	−4.9	1869, Jan. 23	−3.1
30	−0.3	Mar. 9	0.0	Nov. 4	−4.4	24	−3.7
Oct. 6	−5.0	15	−4.5	5	−4.1	28	−6.5
26	+1.6	Apr. 15	−5.6	10	−2.6	Feb. 15	−4.2
28	+0.8	May 8	−2.1	19	−6.8	19	−2.7
Nov. 27	−0.2	11	−3.7	Dec. 5	−3.7	Mar. 23	−3.4
Dec. 26	−0.2	June 9	−0.7	6	−3.6	Apr. 16	−3.5
1858, Feb. 19	−0.5	July 15	−2.8	1865, Jan 8	−3.4	May 18	−3.6
20	−0.2	21	−1.3	12	−5.0	Aug. 2	−9.1
Apr. 25	−1.9	Aug. 1	−3.3	Feb. 2	−3.3	13	−6.3
May 18	−1.9	Sept. 3	−2.5	9	−4.8	19	−6.1
19	−1.7	Oct. 11	−2.5	Mar. 3	−3.5	29	−7.0
20	−1.7	29	−2.0	15	−6.5	Nov. 10	−6.9
Aug. 30	−6.0	Dec. 7	−2.2	Apr. 30	−3.9	17	−6.0
Sept. 18	−0.1	10	−4.5	July 3	−4.8	Dec. 8	−6.5
21	−1.2	13	−5.9	8	−6.2	14	−5.3
Oct. 14	+0.7	1863, Jan. 9	−6.4	Aug. 6	−6.5	1870, Jan. 5	−5.9
21	−2.4	27	−1.4	Sept. 11	−6.9	Feb. 7	−3.4
Nov. 22	−5.8	Feb. 23	−1.4	29	−4.1	9	−2.9
Dec. 22	−5.8	Mar. 2	−3.8	Oct. 4	−6.3	10	−2.9
1859, Jan. 21	−4.9	12	−7.1	Nov. 4	−6.0	11	−3.1
Feb. 8	+0.6	22	−1.5	5	−6.5	12	−2.5
11	0.0	24	−0.6	Dec. 30	−4.2	22	−9.3
16	−2.9	Apr. 2	−5.1	1866, Jan. 8	−6.4	Mar. 10	−2.8
Apr. 11	−2.3	7	−6.8	Feb. 27	−5.6	23	−9.1
13	−2.4	8	−7.6	Apr. 20	−5.0	June 16	−8.2
May 5	−2.2	9	−7.4	May 11	−7.6	July 10	−6.3
7	−2.6	21	−1.6	20	−4.7	Aug. 9	−6.5
Aug. 18	−2.7	25	−2.0	June 18	−4.5	17	−7.2
Sept. 21	−6.0	26	−2.1	July 8	−8.2	19	−6.6
Oct. 28	−1.7	29	−4.0	26	−5.7	Sept. 6	−6.7
Nov. 8	−1.5	30	−4.6	31	−8.9	7	−6.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1870, Sept. 16	− 6.7	1874, Mar. 31	− 7.5	1877, Sept. 25	− 9.2	1880, May 18	−10.0
28	− 6.2	Apr. 22	−11.0	Nov. 20	− 8.3	26	−14.6
Oct. 1	− 6.2	May 19	− 8.9	22	− 8.7	June 13	− 9.0
14	− 9.9	July 8	−11.4	1878, Jan. 10	− 4.8	14	− 9.3
Nov. 9	− 7.8	Aug. 20	− 5.4	Feb. 15	− 9.4	18	−11.9
Dec. 27	− 7.1	31	− 6.3	Mar. 7	− 4.8	20	−12.9
1871, Jan. 11	− 7.5	Oct. 22	− 7.4	16	− 9.9	21	−13.6
Feb. 1	− 5.5	25	− 8.3	Apr. 9	− 6.6	25	−13.7
28	− 4.7	Nov. 19	− 7.0	13	− 9.3	30	−11.1
Mar. 3	− 4.8	Dec. 16	− 8.4	May 26	− 6.3	July 17	−11.7
May 5	− 6.8	19	− 7.2	June 5	− 8.8	19	−12.4
June 29	− 5.8	1875, Jan. 16	− 7.3	14	−10.0	20	−12.6
Sept. 7	− 8.4	20	− 9.1	27	− 7.2	27	−11.9
22	− 5.6	30	− 7.4	Aug. 6	−10.2	30	−10.5
27	− 7.8	Feb. 13	− 7.8	Sept. 5	− 9.2	Aug. 16	−11.4
Oct. 3	− 8.5	Mar. 16	− 8.9	6	− 8.8	28	−10.7
21	− 6.3	May 12	− 9.0	17	− 8.6	Sept. 11	−11.4
23	− 6.6	Aug. 10	− 6.0	Oct. 5	− 8.2	12	−11.0
27	− 7.2	13	− 5.7	Nov. 10	− 8.2	13	−11.1
Nov. 15	− 6.7	Sept. 10	− 5.9	13	−10.4	14	−10.8
18	− 7.4	12	− 6.1	Dec. 2	− 6.5	17	−10.0
27	− 6.9	14	− 7.7	7	− 7.3	25	−10.7
Dec. 1	− 7.1	Oct. 3	− 7.3	1879, Jan. 6	− 8.6	Oct. 7	−12.5
18	− 8.1	16	−11.0	Feb. 3	− 8.1	10	−11.6
20	− 7.5	20	−13.0	26	− 6.0	15	−10.0
1872, Jan. 23	− 5.6	24	−12.2	28	− 6.1	Nov. 17	− 9.8
Feb. 21	− 5.8	Nov. 8	− 6.2	Apr. 1	− 8.2	19	−10.3
Apr. 25	− 8.8	16	−12.7	14	−12.3	20	−10.6
May 19	− 4.6	21	−12.4	25	− 6.8	Dec. 12	−11.3
22	− 6.8	Dec. 7	− 5.8	26	− 7.4	1881, Jan. 5	−11.9
July 22	− 9.7	9	− 7.6	30	− 8.7	7	−10.7
Aug. 12	− 4.9	1876, Jan. 1	− 9.4	May 3	−10.9	9	−10.9
15	− 6.3	7	− 8.0	28	− 9.3	12	−10.8
Sept. 15	− 7.9	10	−10.5	June 30	−11.3	Feb. 6	− 9.4
21	−10.9	Feb. 2	− 6.4	July 28	−11.1	Mar. 8	− 8.5
24	−10.3	16	− 9.7	Aug. 9	− 9.1	16	−13.1
Oct. 11	− 5.8	Mar. 4	− 8.4	10	− 9.1	18	−14.7
14	− 7.4	5	− 8.7	25	−11.3	May 4	− 8.7
15	− 8.4	6	− 9.4	28	−10.1	11	−12.6
Dec. 9	− 7.3	Apr. 1	− 8.6	Sept. 6	− 9.1	21	−13.3
1873, Jan. 22	− 7.0	4	− 9.3	26	− 9.7	July 5	−11.2
Mar. 1	− 8.4	7	− 9.8	Oct. 4	− 9.0	18	−12.5
5	− 8.2	11	− 9.2	24	− 9.6	Aug. 15	−12.6
Apr. 2	− 7.4	May 4	− 9.5	30	− 8.2	Sept. 3	−11.8
30	− 7.9	5	− 9.2	31	− 8.4	Oct. 3	−11.3
May 1	− 7.1	June 1	− 9.2	Nov. 16	−12.8	5	−11.2
5	− 5.3	5	− 8.2	18	−11.7	9	−11.6
11	− 5.8	29	− 9.5	22	− 8.6	31	−11.2
16	− 9.2	30	− 8.9	Dec. 1	−10.4	Nov. 1	−11.0
June 5	− 4.3	July 13	− 9.2	22	− 7.6	12	−10.3
July 1	− 4.9	16	−10.7	27	− 8.4	29	−11.1
2	− 4.5	Oct. 5	−10.1	1880, Jan. 16	− 9.2	Dec. 24	−13.1
4	− 4.1	6	−10.9	20	− 7.1	27	−11.7
19	−10.6	27	− 4.7	28	−11.7	30	−10.1
Aug. 6	− 6.3	Nov. 23	− 4.0	Feb. 5	−14.8	1882, Feb. 7	−13.1
9	− 8.7	24	− 4.2	12	−10.1	11	−14.3
10	− 9.7	29	− 7.6	18	− 6.8	12	−14.4
11	−10.1	30	− 8.6	Mar. 3	−16.1	Mar. 8	−14.4
12	−10.6	Dec. 26	− 6.3	4	−15.8	Apr. 1	−11.9
18	− 9.4	1877, Jan. 30	−12.2	13	− 8.4	20	−11.9
Oct. 3	− 7.0	Feb. 26	−10.4	18	− 6.5	May 6	−16.0
9	−10.9	Mar. 23	− 8.0	21	− 8.0	29	−12.3
13	− 9.9	26	− 9.6	25	−12.2	June 4	−16.1
Dec. 1	− 7.5	Apr. 22	− 9.0	30	−15.6	July 2	−13.6
24	− 6.1	26	− 9.8	Apr. 1	−15.6	21	−12.0
1874, Jan. 25	− 7.5	May 31	− 8.0	2	−15.0	Aug. 2	−15.5
26	− 7.5	July 6	− 8.5	11	− 8.1	18	−12.2
27	− 7.8	Aug. 29	− 9.1	16	− 7.6	27	−14.1
30	− 7.9	30	− 9.7	20	−11.2	Sept. 7	−13.3
Mar. 26	− 8.5	Sept. 18	− 7.0	26	−14.5	20	−12.2

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
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1882, Oct. 1	−14.8	1885, Jan. 4	−0.8	1886, Apr. 10	+5.2	1888, Jan. 15	−1.6
22	−11.7	20	+2.4	14	+4.5	27	+1.8
24	−12.2	21	+3.0	15	+4.0	Mar. 9	−2.4
Nov. 2	−14.1	22	+3.6	May 6	+3.6	18	+1.9
18	−12.1	23	+4.4	14	+2.7	25	+3.2
26	−12.7	24	+4.6	16	+0.9	July 17	+4.0
Dec. 5	−13.7	25	+4.2	21	−1.8	20	+2.1
1883, Jan. 4	−2.2	26	+4.6	June 6	+4.3	21	+1.1
11	0.0	28	+3.4	10	+3.1	23	−0.7
12	+0.6	Feb. 1	+0.3	15	−0.5	25	−1.6
13	+1.0	20	+3.8	July 8	+2.7	28	−2.9
Feb. 14	−1.4	21	+4.5	Aug. 8	+0.6	Aug. 17	+2.1
Mar. 12	+1.4	22	+4.7	19	−1.2	20	−0.5
Apr. 17	0.0	23	+4.8	24	+1.0	Sept. 13	+2.4
28	−3.2	24	+4.4	Sept. 5	−0.1	16	+0.4
May 13	+1.0	Mar. 4	−1.2	7	−0.4	Oct. 9	+2.0
17	−0.3	21	+3.6	Oct. 7	−1.1	13	+0.7
June 14	−0.4	22	+4.0	22	+0.9	15	−0.4
July 15	−1.0	23	+4.2	Nov. 1	−1.9	20	−2.1
17	−1.3	27	+2.7	12	+0.6	Nov. 15	−1.2
19	−1.6	28	+2.1	14	+0.9	Dec. 20	−0.4
21	−2.0	Apr. 2	−1.7	Dec. 3	−1.3	1889, Jan. 8	−1.2
Aug. 24	−1.5	4	−2.1	6	+0.2	12	−0.6
Sept. 6	−1.6	18	+3.4	18	+0.2	14	−0.2
7	−1.5	19	+1.0	1887, Jan. 5	+2.0	Feb. 5	−1.1
14	−0.7	20	+3.6	6	+2.4	9	0.0
16	−1.0	21	+3.5	11	+1.3	12	+0.8
Oct. 23	−2.4	22	+3.1	12	+0.8	Mar. 10	+1.0
Nov. 13	+1.2	24	+2.1	19	−2.1	11	+1.3
1884, Jan. 2	+0.9	26	+0.7	28	−0.4	23	−1.1
7	+3.5	May 5	−2.3	30	+1.1	Apr. 20	−1.4
Feb. 6	+3.0	19	+3.2	Feb. 1	+2.3	June 5	+3.9
16	−3.3	22	+2.3	4	+3.5	10	+3.5
17	−3.2	24	+0.7	6	+3.1	July 19	−2.3
Mar. 3	+2.6	June 23	−1.3	7	+2.9	Aug. 8	+2.6
6	+2.1	25	−2.2	18	−3.2	Sept. 4	+3.3
8	+1.1	28	−3.4	Mar. 2	+3.8	16	−1.1
9	+0.3	July 1	−2.9	8	+3.7	30	+3.5
15	−3.0	6	−0.1	13	−1.3	Oct. 5	+1.7
24	−0.1	7	+0.6	14	−2.2	29	+2.1
Apr. 4	+1.3	9	+1.7	31	+4.8	Nov. 29	+1.2
6	−0.2	21	−0.6	Apr. 4	+5.2	Dec. 1	+0.8
30	+1.9	22	−1.3	6	+3.9	29	+0.7
May 1	+1.6	26	−2.6	9	+0.5	31	+0.4
2	+1.3	Aug. 20	−1.8	15	−3.7	1890, Jan. 3	+0.2
8	−2.6	31	−0.3	30	+5.4	15	−1.9
29	+1.3	Sept. 1	+0.1	May 1	+5.6	Feb. 7	+0.4
30	+1.2	2	+0.6	4	+4.1	12	+0.3
June 5	−1.9	5	+0.6	June 3	+2.5	14	+0.2
28	−0.2	16	−2.5	13	−2.9	Mar. 14	−0.4
July 3	−1.5	17	−1.9	July 1	+1.9	Apr. 7	0.0
11	−2.6	20	−1.7	6	−2.2	15	−1.2
15	−1.4	21	−1.2	16	+0.5	28	+0.6
30	−1.7	30	+0.6	29	+1.8	30	+1.7
Aug. 15	−0.8	Oct. 1	+0.6	Aug. 1	−0.6	May 3	+1.3
Sept. 8	−0.9	14	−2.4	5	−2.9	9	−1.3
12	−0.5	16	−2.1	8	−2.7	30	+2.4
13	−0.5	Nov. 17	+0.4	14	+1.0	June 2	+1.2
14	−0.9	22	+1.2	31	−1.9	4	−0.1
15	−0.7	Dec. 2	−1.2	Sept. 3	−2.7	5	−0.5
26	−1.3	28	−1.6	13	+1.4	6	−1.1
28	−1.0	1886, Jan. 14	+3.9	Oct. 12	+0.9	29	+2.4
Oct. 9	−0.8	16	+4.5	26	−1.1	July 12	−2.6
28	+0.4	18	+3.8	28	−1.1	21	+1.8
30	+0.8	Feb. 9	+3.4	Nov. 7	+0.5	Aug. 26	+3.0
Nov. 22	+0.3	12	+5.3	21	−1.5	Sept. 1	−1.5
25	+1.9	13	+5.5	22	−1.4	6	−2.6
29	+2.5	14	+5.6	24	−1.1	20	+3.3
Dec. 1	+1.8	Mar. 9	+3.2	Dec. 17	−1.6	27	+0.7
30	+3.1	Apr. 8	+4.1	27	+0.6	30	−1.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1890, Oct. 24	+1.6	1893, Feb. 26	+1.8	1894, Nov. 20	−2.1	1895, Sept. 5	+0.4
27	−0.2	Mar. 25	+2.1	Dec. 1	+2.0	6	0.0
Nov. 17	+2.4	Apr. 18	+1.7	2	+2.0	9	−1.0
20	+2.3	21	+2.0	8	+1.7	10	−1.2
21	+1.8	22	+2.0	10	+0.8	11	−1.6
Dec. 1	−1.4	23	+2.0	11	+0.4	15	−1.6
20	+1.4	May 6	−1.0	1895, Jan. 1	+2.8	29	+1.5
23	+0.5	8	−0.9	20	−1.5	30	+1.5
1891, Jan. 4	+0.2	June 24	+0.8	31	+3.1	Oct. 1	+1.4
Feb. 12	+0.5	July 1	−0.9	Feb. 6	+2.7	4	+0.4
17	+0.5	6	−1.3	7	+1.7	7	−0.8
20	+0.3	9	−1.0	8	+1.4	9	−1.7
21	+0.2	30	−0.8	13	−1.3	10	−1.7
Mar. 15	+0.2	Aug. 2	−1.2	18	−1.1	11	−1.8
19	+0.6	21	+0.5	Mar. 3	+3.2	28	+1.4
26	−1.0	Sept. 3	−1.5	4	+3.3	29	+1.4
28	−0.4	23	0.0	5	+3.3	31	+0.9
Apr. 15	+0.2	Oct. 19	+1.4	6	+3.3	Nov. 1	+0.5
18	+0.4	20	+1.2	8	+2.3	3	−0.4
20	+0.7	26	−1.4	9	+2.0	10	−1.5
25	−0.3	30	−2.2	10	+1.5	25	+1.9
May 4	−1.6	Nov. 19	+2.0	11	+0.9	27	+1.5
10	−0.7	22	+0.7	12	+0.4	28	+1.0
14	+0.2	24	−0.5	29	+2.0	29	+0.7
28	−2.1	Dec. 13	+2.6	30	+2.4	30	0.0
June 12	+0.5	20	+2.3	31	+2.5	Dec. 6	−2.4
July 18	+1.1	1894, Jan. 12	+2.9	Apr. 1	+2.8	10	−2.0
22	−1.2	16	+3.6	2	+2.9	28	+1.5
Aug. 14	+1.9	18	+3.1	3	+2.8	29	+0.5
18	+0.4	20	+2.1	4	+2.6	1896, Jan. 7	−2.9
20	−1.2	Feb. 13	+3.3	7	+1.7	8	−2.3
24	−2.9	15	+3.2	10	+0.6	19	+3.2
Oct. 12	+2.3	16	+3.1	11	+0.2	21	+3.6
14	+1.5	26	+0.4	12	+0.1	22	+3.4
15	+1.3	28	+0.4	28	+2.2	24	+2.8
Nov. 6	+1.9	Mar. 14	+2.7	29	+2.2	26	+1.9
7	+2.2	16	+2.6	30	+2.3	27	+1.2
10	+2.3	17	+2.4	May 1	+2.3	28	+0.3
19	−2.2	22	+1.2	2	+2.4	31	−1.9
1892, Jan. 19	−1.5	23	+0.7	3	+2.2	Feb. 19	+3.7
Feb. 1	+1.3	25	+0.8	4	+1.9	20	+3.8
7	+0.7	31	+1.4	5	+1.6	21	+3.5
23	−0.3	Apr. 9	+2.4	6	+1.4	22	+3.4
Mar. 8	−0.7	10	+2.5	7	+1.0	23	+3.0
16	−2.0	11	+2.5	9	+0.4	24	+2.5
Apr. 2	+0.5	12	+2.7	28	+2.2	26	+1.3
May 8	−0.2	24	+0.7	29	+2.2	Mar. 1	−1.4
13	−1.3	25	+0.7	30	+2.3	8	−0.9
June 8	−0.2	29	+1.4	31	+2.3	9	−0.5
14	−1.8	May 2	+1.6	June 9	−0.3	21	+3.2
July 4	+0.3	12	+2.4	12	−0.3	22	+3.2
6	+0.1	14	+2.2	13	−0.3	23	+3.0
11	−1.3	21	+0.1	15	−0.3	25	+2.2
13	−2.0	30	+0.6	16	0.0	27	+1.2
19	−2.0	July 15	+2.2	26	+1.9	Apr. 1	−1.0
Aug. 2	+0.6	17	+1.4	27	+1.9	7	+0.4
3	+0.6	Aug. 4	+0.2	July 2	+1.5	15	+2.3
4	+0.7	23	−1.4	9	−0.4	17	+2.5
11	−2.4	Sept. 11	+1.5	14	−0.6	19	+2.7
Sept. 6	−0.8	21	−1.5	15	−0.6	20	+2.5
7	−1.5	Oct. 7	+1.1	16	−0.6	22	+2.4
11	−3.0	10	+1.1	17	−0.5	25	+1.7
12	−3.0	11	+0.9	18	−0.2	26	+1.0
15	−2.5	19	+2.4	30	+1.8	May 1	+0.2
Oct. 3	+0.8	21	−1.6	Aug. 7	−0.3	16	+2.2
4	+0.4	23	−1.4	10	−0.8	17	+2.1
31	+2.3	Nov. 7	+1.6	12	−1.1	20	+2.0
Nov. 30	+2.4	9	+0.9	13	−1.2	21	+1.9
Dec. 12	−1.2	15	−1.9	16	−1.2	23	+1.3
25	+2.7	16	−2.5	Sept. 2	+1.1	25	+0.8

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
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1896, May 26	+0.6	1897, Aug. 14	+2.2	1899, May 12	+1.8	1901, Apr. 22	+1.1
31	+0.5	17	+3.2	26	−3.7	24	+1.5
June 2	+0.9	Sept. 9	+2.0	June 13	+1.9	28	+1.1
3	+0.9	18	+0.9	25	−3.5	May 5	−2.6
14	+2.0	Oct. 1	+1.4	July 18	−0.8	31	−1.7
15	+1.8	3	+2.1	20	−1.6	June 4	−3.5
19	+1.7	8	+3.0	Aug. 26	−1.4	5	−4.0
22	+1.1	30	+1.1	27	−1.0	12	−2.1
24	+0.9	Nov. 4	+3.1	Oct. 11	−0.1	22	+0.2
July 6	+1.4	Dec. 2	+2.5	12	+1.6	25	−0.3
20	+1.6	5	+3.1	27	−0.8	29	−2.3
27	+0.1	6	+3.2	Nov. 11	+0.9	July 10	−2.4
28	0.0	7	+3.0	13	+1.1	25	−1.4
31	+0.1	13	+0.1	14	+1.1	28	−2.3
Aug. 5	−1.2	25	−0.2	18	+0.3	Aug. 9	−1.8
20	+1.9	27	+0.8	Dec. 8	+0.1	19	−0.4
21	+1.5	1898, Jan. 2	+2.8	13	+1.8	22	−1.2
23	+1.1	3	+2.8	16	+1.0	24	−1.5
27	+0.2	5	+2.1	1900, Jan. 9	+1.5	30	−2.9
28	−0.1	10	−0.4	11	−0.7	Sept. 25	−1.4
29	+0.5	26	+1.9	23	−2.8	Oct. 17	−1.5
30	0.0	Feb. 5	+0.3	Feb. 3	−0.1	19	−0.9
Sept. 3	−0.5	13	−2.7	6	+1.1	21	−0.6
5	−0.5	25	+2.5	7	+0.3	23	−0.4
14	+1.9	Mar. 1	+2.9	12	+0.8	24	−0.4
18	+2.1	2	+2.2	Mar. 5	+0.5	27	−1.0
23	+1.0	5	+0.9	7	+1.2	29	−1.5
26	−0.3	13	−3.4	8	+1.4	Nov. 16	−0.7
28	−0.8	17	−1.8	23	−3.8	Dec. 18	+1.0
29	−0.9	26	+2.9	26	−3.1	19	+1.5
Oct. 9	−0.1	Apr. 1	+2.3	Apr. 2	−0.1	21	+1.6
10	−0.1	2	+1.1	4	+0.9	22	+1.6
16	+1.9	4	+0.3	5	+0.9	1902, Jan. 18	+2.5
18	+2.0	25	+2.4	May 1	+0.1	19	+2.6
24	+0.2	28	+2.2	7	+0.6	31	−1.8
25	−0.1	29	+2.4	16	−4.3	Feb. 12	+1.1
27	−0.6	May 2	+1.1	20	−3.7	13	+1.5
30	−1.1	16	−0.5	June 2	+0.6	14	+2.0
Nov. 9	+0.2	June 5	−1.5	8	−1.0	15	+2.4
10	+0.6	6	−1.5	14	−4.3	16	+2.8
12	+1.1	13	−0.4	July 6	−0.5	17	+2.7
13	+1.3	30	+2.9	10	−2.5	Mar. 17	+2.6
15	+1.5	July 30	+0.6	11	−3.3	20	+2.5
16	+1.6	Aug. 6	−0.5	Aug. 7	−1.6	25	−0.1
17	+1.4	25	+0.8	8	−2.1	28	−1.5
26	−1.4	Sept. 3	−0.3	17	−2.8	29	−1.8
Dec. 16	+1.1	23	+1.1	Sept. 1	−0.4	Apr. 21	+0.4
17	+1.8	28	+1.1	2	−0.5	May 10	+0.9
18	+0.7	Oct. 20	+0.7	4	−0.9	11	+1.5
1897, Jan. 7	+1.5	24	+2.1	12	−3.0	12	+1.6
10	+2.0	Nov. 16	−0.5	13	+1.8	14	+2.0
11	+2.1	22	+2.3	28	−0.4	15	+2.0
17	−0.2	Dec. 19	+0.8	Oct. 3	−0.3	17	+1.5
23	−2.7	23	+2.4	Nov. 13	−0.4	18	+1.0
27	−1.6	30	+0.9	26	−0.5	19	+0.8
Feb. 13	+1.5	1899, Jan. 19	+1.9	Dec. 5	+0.9	25	−2.4
23	−2.7	Feb. 2	−2.3	9	0.0	June 10	+1.2
Apr. 12	+2.8	4	−3.1	1901, Jan. 28	+1.9	15	+0.8
14	+1.8	18	+2.3	30	+2.4	17	−0.2
19	−1.5	19	+2.4	Feb. 15	−2.3	18	−0.6
May 5	+2.9	21	+2.0	21	−0.1	23	−2.6
11	+2.5	22	+1.6	25	+1.9	25	−3.2
July 3	+2.2	Mar. 16	+1.9	26	+2.2	27	−3.2
12	+0.8	20	+2.5	Mar. 10	−1.8	28	−3.0
13	+0.7	Apr. 15	+2.6	25	+1.4	July 11	+0.6
20	+3.5	17	+2.7	26	+1.9	15	−0.3
23	+2.2	19	+1.9	28	+2.2	18	−1.6
Aug. 1	−1.5	28	−4.2	Apr. 4	−0.4	19	−2.0
4	+1.7	May 1	−4.5	7	−2.2	21	−2.8
9	+1.4	3	−3.5	10	−2.9	22	−3.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1902, July 28	−2.6	1904, Jan. 4	−0.9	1905, Aug. 23	−0.9	1906, Oct. 26	−0.6
Oct. 10	−1.1	Feb. 24	+2.3	Sept. 9	+0.1	28	−1.0
11	−1.2	29	+1.7	11	−1.5	Nov. 5	−0.2
16	−1.9	Mar. 4	−0.9	12	−0.8	19	−0.6
19	−2.6	22	+2.2	17	−0.7	21	−0.8
21	−2.7	27	+2.6	18	−0.6	22	−0.8
22	−2.6	Apr. 22	+3.4	19	−0.1	Dec. 5	+0.8
23	−2.6	24	+3.2	Oct. 4	0.0	19	−1.8
24	−2.4	28	+0.6	11	−0.8	25	−1.6
Nov. 6	−1.2	May 1	−1.8	Nov. 7	−1.2	1907, Jan. 20	−1.9
8	−0.9	21	+3.3	Dec. 2	−1.7	26	0.0
11	−0.6	24	+2.5	9	−0.2	27	+0.5
14	−0.9	June 4	−3.1	10	0.0	Feb. 1	+0.5
17	−1.7	July 7	−1.4	1906, Jan. 1	−1.0	16	−1.5
18	−2.1	9	−0.3	4	+0.8	21	+0.6
19	−2.2	18	+1.7	6	+0.4	22	+1.4
20	−2.4	22	+0.5	10	+0.5	23	+1.3
22	−2.4	Aug. 30	−2.2	13	−0.1	25	+1.6
Dec. 4	−1.2	Sept. 13	−0.5	Feb. 3	+1.2	Mar. 10	−3.2
11	+0.6	22	−2.6	4	+1.7	20	+0.8
12	+0.6	27	−1.8	7	+1.8	21	+1.4
13	+0.1	29	−1.4	8	+1.6	22	+2.3
1903, Jan. 6	+1.1	Oct. 27	−1.3	Mar 2	+1.9	24	+3.0
9	+1.6	Nov. 20	−1.4	3	+2.3	28	+2.0
12	+1.0	23	−1.2	4	+3.0	Apr. 19	+2.3
14	−0.3	Dec. 16	−0.9	17	−3.2	25	+3.0
15	−0.7	20	0.0	20	−4.0	May 24	+3.3
18	−2.0	1905, Jan. 10	−1.7	29	+1.0	June 18	+3.6
19	−2.4	16	+1.4	31	+2.8	21	+2.7
20	−2.7	17	+1.2	Apr. 2	+3.6	24	+0.9
Feb. 2	+0.5	18	+1.5	3	+3.9	July 23	+0.9
6	+2.4	19	+1.4	4	+4.0	26	−2.9
7	+2.4	26	−2.1	5	+4.0	Aug. 18	+2.8
9	+2.0	Feb. 13	+2.3	6	+3.6	Sept. 14	+2.9
12	+0.6	17	+3.0	10	+0.2	15	+2.9
15	−1.6	20	+1.2	11	−0.4	16	+2.1
16	−2.1	21	+0.2	14	−3.0	18	+0.7
19	−3.2	Mar. 10	+0.6	27	+1.1	19	−0.4
Mar. 2	+1.3	12	+2.4	May 1	+4.3	24	−3.8
4	+1.6	15	+3.8	2	+4.3	26	−3.6
5	+2.4	16	+4.0	3	+4.7	Oct. 2	+0.3
6	+2.6	17	+3.8	8	+1.6	24	−2.6
7	+2.8	18	+3.2	9	0.0	Nov. 16	−0.8
8	+2.9	19	+2.8	11	−1.0	Dec. 11	−0.8
12	+1.0	20	+2.2	17	−3.8	17	−1.3
17	−2.4	Apr. 12	+4.0	June 2	+3.3	1908, Jan. 18	−0.3
Apr. 4	+2.8	15	+3.9	4	+2.3	29	+0.7
May 2	+2.4	16	+3.2	7	−0.5	Mar. 7	−1.8
June 2	+1.6	17	+2.8	8	−1.4	10	−1.0
Aug. 1	−1.3	24	−2.8	25	+4.6	13	0.0
Sept. 2	−2.4	May 10	+4.1	July 2	+2.6	23	−1.2
3	−2.6	13	+4.2	5	+1.9	Apr. 6	−0.7
Oct. 22	−2.1	14	+3.7	8	−3.2	9	+0.9
30	−1.6	15	+3.0	Aug. 9	−4.0	13	+1.5
Nov. 4	−1.7	July 7	+4.2	Sept. 1	−0.6	June 11	+2.7
9	−2.3	13	+1.3	5	−3.5	15	−0.5
Dec. 2	−0.4	20	−2.7	9	−2.6	16	−1.8
4	−0.8	Aug. 7	+2.6	Oct. 8	−0.5	July 17	+0.7
10	−2.4	12	+3.8	11	−0.2	Aug. 3	+3.1
31	+0.5	17	−1.9	25	0.0	9	+0.9
						10	0.0

CHAPTER VI.

POSITIONS OF THE OCCULTED STARS.

The positions of the occulted stars have been taken primarily from the Catalogue of Zodiacal Stars in Astronomical Papers of the American Ephemeris, Vol. VIII, Part III. The positions of the occulted stars observed by Batterman, published in Beobachtungs-Ergebnisse der Königlichen Sternwarte zu Berlin, Hefte 5, 11, und 13, have been used unchanged. The right ascensions as found in the printed catalogue are not corrected for the magnitude equation. This correction, however, has been applied to the adopted positions, or in many cases the final numbers have been corrected for this equation. The adopted expression for the magnitude equation is

$$\Delta\alpha = 0^s.008\ (4.0 - m),$$

m being the magnitude of the star.

The positions of the stars occulted before 1847 were not corrected for this equation before being transformed into ecliptic coordinates. This transformation was made for the epoch 1900, the adopted obliquity being that of the author's Tables of the Sun,

$$\varepsilon = 23^\circ\ 27'\ 8''.26.$$

For convenient comparison with the positions used in Researches I, these longitudes and latitudes were reduced back to 1850.0, and were then corrected for the magnitude equation. The positions thus derived are given in the following list, in which is included the magnitude equation, which, however, it should be noted, is actually applied to derive the longitudes and latitudes as printed.

After reduction to the epoch of observation by the formulæ for precession and proper motion found in Chapter II, the positions are corrected for aberration. The adopted corrections are:

$$\Delta L = -20''.50 \sec B \cos (\odot - L),$$
$$\Delta B = -20''.50 \sin B \sin (\odot - L).$$

This value of the aberration is tabulated in the following tables, the arguments being in all cases the excess of the sun's longitude over that of the star.

The algebraic signs of the aberration for positive latitudes are shown at the top and bottom of the columns of arguments. It should be noted that the aberration in latitude changes sign with the latitude.

Table of Aberration Correction.

ΔL.

$\odot-L$		$B=0^\circ$	$B=2^\circ$	$B=4^\circ$	$B=6^\circ$	$B=8^\circ$	$\odot-L$	
+	−	$''$	$''$	$''$	$''$	$''$	+	−
180°	0°	20.50 $_{1}$	20.51 $_{1}$	20.55 $_{1}$	20.61 $_{1}$	20.70 $_{1}$	180°	360°
182	2	20.49 $_{4}$	20.50 $_{4}$	20.54 $_{4}$	20.60 $_{4}$	20.69 $_{4}$	178	358
184	4	20.45 $_{6}$	20.46 $_{6}$	20.50 $_{6}$	20.56 $_{6}$	20.65 $_{6}$	176	356
186	6	20.39 $_{9}$	20.40 $_{9}$	20.44 $_{9}$	20.50 $_{9}$	20.59 $_{9}$	174	354
188	8	20.30 $_{11}$	20.31 $_{11}$	20.35 $_{11}$	20.41 $_{11}$	20.50 $_{11}$	172	352
190	10	20.19 $_{14}$	20.20 $_{14}$	20.24 $_{14}$	20.30 $_{14}$	20.39 $_{14}$	170	350
192	12	20.05 $_{16}$	20.06 $_{16}$	20.10 $_{16}$	20.16 $_{16}$	20.25 $_{16}$	168	348
194	14	19.89 $_{19}$	19.90 $_{18}$	19.94 $_{19}$	20.00 $_{19}$	20.09 $_{19}$	166	346
196	16	19.70 $_{21}$	19.72 $_{21}$	19.75 $_{21}$	19.81 $_{21}$	19.90 $_{21}$	164	344
198	18	19.49 $_{23}$	19.51 $_{23}$	19.54 $_{23}$	19.60 $_{23}$	19.69 $_{23}$	162	342
+	−						+	−

Table of Aberration Correction—Continued.

ΔL.

$\odot - L$		$B=0°$	$B=2°$	$B=4°$	$B=6°$	$B=8°$	$\odot - L$	
+	−	″	″	″	″	″	+	−
200°	20°	19.26_{25}	19.28_{26}	19.31_{25}	19.37_{26}	19.46_{26}	160°	340°
202	22	19.01_{28}	19.02_{28}	19.06_{28}	19.11_{28}	19.20_{29}	158	338
204	24	18.73_{31}	18.74_{30}	18.78_{31}	18.83_{31}	18.91_{31}	156	336
206	26	18.42_{32}	18.44_{33}	18.47_{33}	18.52_{32}	18.60_{33}	154	334
208	28	18.10_{35}	18.11_{35}	18.14_{35}	18.20_{35}	18.27_{35}	152	332
210	30	17.75_{37}	17.76_{37}	17.79_{37}	17.85_{37}	17.92_{37}	150	330
212	32	17.38_{39}	17.39_{39}	17.42_{39}	17.48_{39}	17.55_{39}	148	328
214	34	16.99_{41}	17.00_{41}	17.03_{41}	17.09_{41}	17.16_{41}	146	326
216	36	16.58_{43}	16.59_{43}	16.62_{43}	16.68_{44}	16.75_{44}	144	324
218	38	16.15_{45}	16.16_{45}	16.19_{45}	16.24_{45}	16.31_{46}	142	322
220	40	15.70_{47}	15.71_{47}	15.74_{47}	15.79_{47}	15.85_{47}	140	320
222	42	15.23_{48}	15.24_{48}	15.27_{49}	15.32_{49}	15.38_{49}	138	318
224	44	14.75_{51}	14.76_{51}	14.78_{51}	14.83_{51}	14.89_{51}	136	316
226	46	14.24_{52}	14.25_{52}	14.27_{52}	14.32_{53}	14.38_{53}	134	314
228	48	13.72_{54}	13.73_{54}	13.75_{54}	13.79_{54}	13.85_{54}	132	312
230	50	13.18_{56}	13.19_{56}	13.21_{56}	13.25_{56}	13.31_{57}	130	310
232	52	12.62_{57}	12.63_{57}	12.65_{57}	12.69_{58}	12.74_{58}	128	308
234	54	12.05_{59}	12.06_{59}	12.08_{59}	12.11_{59}	12.16_{59}	126	306
236	56	11.46_{60}	11.47_{60}	11.49_{61}	11.52_{60}	11.57_{61}	124	304
238	58	10.86_{61}	10.87_{61}	10.88_{61}	10.92_{62}	10.96_{61}	122	302
240	60	10.25_{62}	10.26_{63}	10.27_{63}	10.30_{62}	10.35_{63}	120	300
242	62	9.63_{64}	9.63_{64}	9.64_{64}	9.68_{64}	9.72_{65}	118	298
244	64	8.99_{65}	8.99_{64}	9.00_{64}	9.04_{66}	9.07_{65}	116	296
246	66	8.34_{66}	8.35_{66}	8.36_{66}	8.38_{66}	8.42_{66}	114	294
248	68	7.68_{67}	7.69_{68}	7.70_{67}	7.72_{67}	7.76_{68}	112	292
250	70	7.01_{68}	7.01_{68}	7.03_{68}	7.05_{68}	7.08_{69}	110	290
252	72	6.33_{68}	6.33_{68}	6.35_{69}	6.37_{69}	6.39_{69}	108	288
254	74	5.65_{69}	5.65_{69}	5.66_{69}	5.68_{69}	5.70_{70}	106	286
256	76	4.96_{70}	4.96_{70}	4.97_{70}	4.99_{71}	5.00_{70}	104	284
258	78	4.26_{70}	4.26_{70}	4.27_{70}	4.28_{70}	4.30_{71}	102	282
260	80	3.56_{71}	3.56_{71}	3.57_{71}	3.58_{71}	3.59_{71}	100	280
262	82	2.85_{71}	2.85_{71}	2.86_{71}	2.87_{72}	2.88_{72}	98	278
264	84	2.14_{71}	2.14_{71}	2.15_{72}	2.15_{71}	2.16_{72}	96	276
266	86	1.43_{71}	1.43_{71}	1.43_{71}	1.44_{72}	1.44_{72}	94	274
268	88	0.72_{72}	0.72_{72}	0.72_{72}	0.72_{72}	0.72_{72}	92	272
270	90	0.00	0.00	0.00	0.00	0.00	90	270
+	−						+	−

ΔB.

$\odot - L$		$B=0°$	$B=1°$	$B=2°$	$B=3°$	$B=4°$	$B=5°$	$B=6°$	$B=7°$	$\odot - L$	
+	−	″	″	″	″	″	″	″	″	−	+
180°	0°	0.00	0.00_{3}	0.00_{6}	0.00_{9}	0.00_{13}	0.00_{16}	0.00_{19}	0.00_{22}	180°	360°
185	5	0.00	0.03_{3}	0.06_{6}	0.09_{10}	0.13_{12}	0.16_{15}	0.19_{18}	0.22_{21}	175	355
190	10	0.00	0.06_{3}	0.12_{6}	0.19_{9}	0.25_{12}	0.31_{15}	0.37_{18}	0.43_{22}	170	350
195	15	0.00	0.09_{3}	0.18_{6}	0.28_{9}	0.37_{12}	0.46_{15}	0.55_{18}	0.65_{20}	165	345
200	20	0.00	0.12_{3}	0.24_{6}	0.37_{8}	0.49_{12}	0.61_{14}	0.73_{17}	0.85_{20}	160	340
205	25	0.00	0.15_{3}	0.30_{6}	0.45_{9}	0.61_{11}	0.75_{14}	0.90_{17}	1.05_{20}	155	335
210	30	0.00	0.18_{3}	0.36_{5}	0.54_{7}	0.72_{10}	0.89_{13}	1.07_{16}	1.25_{18}	150	330
215	35	0.00	0.21_{2}	0.41_{5}	0.61_{8}	0.82_{10}	1.02_{13}	1.23_{15}	1.43_{18}	145	325
220	40	0.00	0.23_{2}	0.46_{5}	0.69_{7}	0.92_{9}	1.15_{11}	1.38_{14}	1.61_{16}	140	320
225	45	0.00	0.25_{2}	0.51_{4}	0.76_{6}	1.01_{9}	1.26_{11}	1.52_{12}	1.77_{14}	135	315
230	50	0.00	0.27_{2}	0.55_{3}	0.82_{6}	1.10_{7}	1.37_{9}	1.64_{11}	1.91_{14}	130	310
235	55	0.00	0.29_{2}	0.58_{4}	0.88_{5}	1.17_{7}	1.46_{9}	1.75_{10}	2.05_{11}	125	305
240	60	0.00	0.31_{2}	0.62_{3}	0.93_{4}	1.24_{6}	1.55_{7}	1.85_{9}	2.16_{11}	120	300
245	65	0.00	0.33_{1}	0.65_{2}	0.97_{4}	1.30_{4}	1.62_{6}	1.94_{8}	2.27_{8}	115	295
250	70	0.00	0.34_{1}	0.67_{2}	1.01_{3}	1.34_{4}	1.68_{5}	2.02_{5}	2.35_{6}	110	290
255	75	0.00	0.35_{0}	0.69_{1}	1.04_{2}	1.38_{3}	1.73_{3}	2.07_{4}	2.41_{5}	105	285
260	80	0.00	0.35_{1}	0.70_{1}	1.06_{1}	1.41_{1}	1.76_{2}	2.11_{2}	2.46_{3}	100	280
265	85	0.00	0.36_{0}	0.71_{1}	1.07_{0}	1.42_{1}	1.78_{0}	2.13_{1}	2.49_{1}	95	275
270	90	0.00	0.36	0.72	1.07	1.43	1.78	2.14	2.50	90	270
+	−									−	+

NOTE.—For B negative, change sign of ΔB.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
10 Ceti	6.4	3 59 35.76	5034.94	+ 8.25	−2 41 26.64	+ 6.26	− 2.33	−0.26	+0.11
44 Piscium	6.1	4 30 15.52	5022.26	− 2.86	−0 44 38.39	+ 7.71	− 1.28	−0.22	+0.09
45 Piscium	7.2	6 50 58.42	5022.53	+ 1.62	+4 30 37.42	+ 4.22	− 6.67	−0.40	+0.16
60 Piscium	6.2	11 25 47.38	5024.59	+ 1.25	+1 31 4.78	+13.46	− 1.06	−0.26	+0.11
62 Piscium	6.1	11 50 55.16	5032.96	+ 9.95	+1 56 49.02	+11.45	− 3.39	−0.24	+0.10
δ Piscium	4.5	12 3 4.62	5028.58	+ 5.74	+2 10 24.15	+ 7.76	− 7.24	−0.07	+0.03
171 B. Piscium	6.3	14 10 36.83	5025.36	+ 0.90	+0 5 4.02	+15.74	− 0.90	−0.28	+0.25
33 Ceti	6.1	15 6 20.35	5026.41	− 1.70	−4 40 8.79	+17.36	0.00	−0.28	+0.24
ε Piscium	4.4	15 26 2.42	5017.25	− 6.45	+1 5 2.75	+23.09	+ 5.48	−0.06	+0.25
35 Ceti	6.8	15 34 33.08	5008.31	−19.91	−4 49 46.79	+15.56	− 2.16	−0.34	+0.13
e Piscium	5.6	15 50 1.73	4994.31	−31.36	−1 29 45.36	+12.41	− 5.50	−0.20	+0.12
f Piscium	5.3	17 13 45.45	5022.17	− 5.58	−4 16 18.63	+18.50	− 0.47	−0.14	+0.14
ζ Piscium	5.3	17 46 42.73	5035.86	+11.17	−0 13 2.65	+ 9.16	−10.23	−0.02	+0.01
88 Piscium	6.2	17 47 20.16	5022.62	− 2.55	−0 50 58.29	+17.63	− 1.77	−0.25	+0.14
95 Piscium	7.3	20 9 58.53	5018.06	− 9.10	−3 34 19.54	+ 9.49	−11.67	−0.48	+0.19
μ Piscium	5.0	21 1 45.49	5053.36	+26.59	−3 4 0.89	+ 8.26	−13.54	−0.14	+0.13
96 Piscium	6.7	21 12 14.39	5021.64	− 4.27	−1 53 54.14	+17.88	− 4.04	−0.32	+0.12
ν Piscium	4.6	23 24 41.92	5025.95	− 1.94	−4 42 16.42	+24.62	+ 1.11	−0.08	+0.03
η Piscium	3.8	24 43 19.93	5022.66	+ 1.91	+5 22 4.26	+23.39	− 1.05	+0.04	−0.03
π Piscium	5.6	24 49 21.84	5017.74	− 5.47	+1 53 1.54	+30.36	+ 5.85	−0.19	+0.07
101 Piscium	6.2	25 26 19.25	5022.78	+ 1.30	+4 21 4.05	+24.26	− 0.68	−0.31	+0.12
o Piscium	4.5	25 38 41.17	5034.07	+ 8.40	−1 37 53.93	+26.65	+ 1.56	−0.05	+0.18
104 Piscium	6.9	26 5 10.05	5028.89	+ 6.93	+3 41 47.03	+19.47	− 5.93	−0.42	+0.15
54 Ceti	6.0	27 34 47.17	5017.23	− 7.53	−0 20 43.39	+26.38	− 0.04	−0.22	+0.07
311 B. Piscium	7.1	27 56 6.85	5033.49	+ 5.00	−5 49 21.14	+22.15	− 4.51	−0.37	+0.17
64 Ceti	5.8	31 28 29.84	5010.91	−16.48	−4 24 4.92	+23.57	− 5.44	−0.20	+0.07
ξ¹ Ceti	4.6	31 56 48.52	5024.99	− 2.30	−4 16 45.40	+28.43	− 0.89	−0.06	+0.02
ξ Arietis	5.5	35 16 56.43	5026.79	+ 0.06	−3 34 0.79	+29.07	− 2.34	−0.17	+0.07
ξ² Ceti	4.3	35 22 21.34	5031.49	+ 3.35	−5 52 4.82	+29.61	− 1.86	−0.05	+0.02
31 Arietis	5.7	38 36 12.79	5049.82	+23.70	−2 43 49.81	+16.63	−16.77	−0.19	+0.06
27 Arietis	6.4	38 56 24.58	5024.01	+ 1.04	+2 41 28.22	+23.85	− 9.75	−0.30	+0.09
85 Ceti	6.3	39 27 30.39	5023.30	− 3.98	−4 47 58.58	+33.90	+ 0.01	−0.28	+0.08
μ Ceti	4.3	39 50 6.03	5053.50	+25.80	−5 34 34.20	+23.24	−10.87	−0.05	+0.02
38 Arietis	5.2	40 32 54.41	5035.30	+ 8.89	−3 21 12.34	+23.39	−11.12	−0.14	+0.05
μ Arietis	5.7	42 14 13.05	5024.25	+ 1.92	+4 2 45.34	+30.79	− 4.65	−0.22	+0.06
σ Arietis	5.4	42 50 55.00	5026.49	+ 1.26	−1 18 28.25	+31.79	− 3.98	−0.18	+0.05
40 Arietis	6.0	43 6 38.60	5026.94	+ 3.46	+1 57 40.09	+32.78	− 3.13	−0.25	+0.11
ρ Arietis	5.6	44 49 27.59	5044.59	+20.67	+1 10 34.37	+ 8.76	−28.04	−0.18	+0.04
47 Arietis	5.8	45 57 9.06	5043.70	+20.98	+3 35 35.64	+28.85	− 8.53	−0.23	+0.06
ε Arietis (mean)	4.6	46 24 19.28	5020.92	− 1.54	+4 9 31.70	+37.04	− 0.57	−0.07	+0.03
53 Arietis	6.0	47 18 15.61	5021.84	− 2.54	+0 17 48.86	+39.16	+ 1.11	−0.32	+0.09
54 Arietis	6.5	47 45 41.91	5026.09	+ 2.10	+1 7 10.48	+36.21	− 2.05	−0.30	+0.08
δ Arietis	4.5	48 45 10.75	5038.63	+14.95	+1 48 35.10	+34.58	− 4.17	−0.06	+0.02
ζ Arietis	4.8	49 51 1.45	5018.44	− 4.77	+2 52 40.66	+32.07	− 7.17	−0.11	+0.03
161 B. Arietis	6.9	50 12 44.37	5032.27	+ 9.89	+4 45 20.98	+32.76	− 6.65	−0.35	+0.10
τ Arietis	5.1	51 18 3.81	5025.66	+ 2.27	+2 35 38.18	+35.88	− 4.02	−0.14	+0.04
f Tauri	4.3	51 29 47.73	5029.46	+ 2.33	−5 55 55.96	+39.58	− 0.39	−0.04	+0.01
65 Arietis	6.0	51 56 25.55	5024.21	+ 0.57	+2 4 17.79	+39.21	− 0.96	−0.19	+0.05
66 Arietis	6.1	53 20 23.14	5020.92	− 2.05	+3 47 1.04	+29.75	−11.01	−0.25	+0.10
7 Tauri	5.9	55 4 40.31	5023.77	+ 1.23	+5 3 38.01	+38.81	− 2.65	−0.23	+0.03
14 H¹. Tauri	6.5	55 16 20.66	5024.00	....	+1 21 52.54	+41.53	....	−0.30	+0.07
9 Tauri	6.7	55 20 44.05	5022.19	− 0.90	+3 42 22.76	+38.02	− 3.54	−0.36	+0.09
14 Tauri	6.2	56 4 40.44	5035.07	+10.50	−0 6 19.74	+34.35	− 7.49	−0.26	+0.06
22 H¹. Tauri	6.1	56 31 6.88	5025.05	+ 0.93	+1 5 18.38	+41.19	− 0.82	−0.25	+0.05
17 Tauri	3.8	57 19 4.21	5023.62	+ 1.01	+4 10 27.19	+37.52	− 5.39	+0.02	−0.01
16 Tauri	5.4	57 20 27.92	5023.56	+ 0.10	+4 20 58.26	+37.53	− 5.03	−0.30	+0.07
q Tauri	4.3	57 28 14.16	5023.51	+ 0.57	+4 30 8.78	+37.57	− 3.62	−0.04	+0.01
18 Tauri	5.6	57 32 35.83	5023.38	− 0.27	+4 52 3.13	+37.59	− 3.81	−0.28	+0.06
20 Tauri	4.1	57 35 10.80	5023.56	+ 1.15	+4 22 27.50	+37.61	− 4.77	0.00	0.00
23 Tauri	4.3	57 36 18.68	5023.72	+ 1.07	+3 56 24.34	+37.62	− 5.43	−0.02	+0.01
21 Tauri	5.8	57 38 44.73	5023.50	+ 0.62	+4 33 9.16	+37.63	− 4.85	−0.22	+0.03
22 Tauri	6.5	57 40 16.06	5023.51	− 0.01	+4 31 9.63	+37.64	− 4.02	−0.30	+0.07
η Tauri	2.9	57 53 53.95	5023.70	+ 1.01	+4 2 6.77	+37.72	− 5.34	+0.12	−0.03
27 Tauri	3.7	58 15 42.81	5023.77	+ 0.61	+3 54 6.08	+37.85	− 5.08	+0.02	−0.01
28 Tauri	5.2	58 17 7.23	5023.32	+ 0.19	+3 58 55.09	+37.86	− 4.82	−0.26	+0.06

The above longitudes and latitudes include the magnitude equation.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.		Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq.	
									ΔL.	ΔB.
			° ′ ″	″	″	° ′ ″	″	″	″	″
33	Tauri	6.0	59 51 0.35	5027.02	+ 3.37	+2 39 45.37	+41.51	− 1.67	−0.36	+0.08
	A Tauri	4.5	61 21 28.74	5032.47	+ 8.32	+1 14 40.86	+36.06	− 7.62	−0.06	+0.01
39	Tauri	6.1	61 29 14.63	5038.56	+14.39	+1 8 53.28	+27.40	−16.30	−0.25	+0.05
36	Tauri	5.6	61 40 31.77	5023.20	− 0.34	+3 14 35.18	+41.56	− 2.20	−0.19	+0.04
43	Tauri	5.5	61 55 0.35	5035.05	+10.11	−1 22 53.39	+37.35	− 6.48	−0.22	+0.05
48	Tauri	6.3	62 42 27.47	5037.91	+11.68	−5 48 19.06	+39.46	− 4.62	−0.29	+0.06
	p Tauri	5.5	63 33 54.10	5019.09	− 3.95	+5 18 5.63	+40.81	− 3.51	−0.19	+0.04
	γ Tauri	3.9	63 42 22.42	5037.59	+11.45	−5 44 56.31	+39.67	− 4.69	+0.01	0.00
58	Tauri	5.4	63 48 36.27	5036.20	+ 9.91	−6 18 24.40	+40.93	− 3.45	−0.13	+0.03
	ω Tauri	4.8	63 57 59.72	5020.64	− 4.10	−0 46 3.77	+39.59	− 4.84	−0.07	+0.02
51	Tauri	5.6	64 23 28.47	5033.54	+ 9.06	+0 10 23.25	+38.77	− 5.77	−0.17	+0.03
53	Tauri	5.3	64 33 37.23	5027.63	+ 3.02	−0 17 56.78	+38.88	− 5.71	−0.18	+0.03
56	Tauri	5.2	64 42 26.37	5028.06	+ 3.62	+0 18 57.19	+39.95	− 4.68	−0.17	+0.03
63	Tauri	5.7	64 45 37.07	5035.90	+10.11	−4 45 36.32	+40.17	− 4.48	−0.19	+0.03
	δ Tauri	3.9	64 46 18.51	5035.74	+10.15	−3 59 10.42	+39.80	− 4.85	0.00	0.00
64	Tauri	4.9	65 1 46.13	5036.74	+11.13	−4 7 41.27	+38.78	− 5.93	−0.11	+0.02
70	Tauri	6.4	65 8 54.18	5036.00	+10.02	−5 40 15.30	+40.41	− 4.34	−0.29	+0.05
71	Tauri	4.6	65 16 9.16	5036.52	+10.44	−6 1 2.61	+41.03	− 3.74	−0.07	+0.01
68	Tauri	4.3	65 26 10.13	5035.89	+10.42	−3 42 15.45	+39.93	− 4.90	−0.02	0.00
	φ Tauri	5.0	65 49 5.74	5019.16	− 3.92	+5 47 9.67	+37.30	− 7.62	−0.13	+0.02
	θ¹ Tauri	4.2	65 51 22.36	5035.76	+ 9.79	−5 45 43.13	+41.00	− 3.93	+0.01	0.00
	θ² Tauri	3.6	65 51 46.22	5036.88	+10.89	−5 51 19.73	+41.08	− 3.85	+0.05	−0.01
75	Tauri	5.2	65 53 23.56	5026.51	+ 0.64	−5 22 0.88	+46.81	+ 1.87	−0.16	+0.03
	χ Tauri	5.3	66 1 17.54	5026.83	+ 3.29	+4 0 12.78	+41.50	− 3.47	−0.20	+0.03
	κ Tauri	4.1	66 6 22.72	5032.22	+ 7.84	+0 36 38.27	+39.39	− 5.60	−0.07	+0.01
62	Tauri	6.1	66 7 17.98	5024.60	+ 0.72	+2 38 25.11	+42.97	− 2.02	−0.26	+0.04
80	Tauri	5.8	66 10 51.33	5034.38	+ 8.36	−6 8 26.31	+42.51	− 2.50	−0.19	+0.03
81	Tauri	5.5	66 18 36.00	5031.41	+ 9.39	−6 6 21.19	+40.31	− 4.73	−0.18	+0.03
264	B. Tauri	4.8	66 21 56.26	5037.47	+11.58	−5 36 22.50	+40.50	− 4.55	−0.22	+0.04
	ε Tauri	3.5	66 21 58.57	5036.05	+10.90	−2 35 1.64	+39.80	− 5.26	+0.04	−0.01
	υ Tauri	4.2	66 24 8.93	5034.24	+ 9.97	+1 5 21.72	+38.57	− 6.49	−0.07	+0.01
247	B. Tauri	5.8	66 36 19.67	5033.39	+ 8.83	−0 9 5.03	+35.90	− 9.20	−0.22	+0.04
85	Tauri	6.0	66 37 28.88	5035.74	+ 9.78	−5 59 31.33	+41.52	− 3.59	−0.30	+0.04
275	B. Tauri	6.5	67 7 18.67	5027.52	+ 1.69	−5 35 23.31	+46.90	+ 1.67	−0.30	+0.04
	α Tauri	1.1	67 41 34.49	5029.62	+ 3.86	−5 28 41.01	+25.63	+ 9.73	+0.36	−0.05
	σ² Tauri	4.9	68 24 31.54	5034.43	+ 8.57	−6 11 1.51	+42.33	− 3.19	−0.10	+0.02
	τ Tauri	4.3	70 3 34.45	5025.06	+ 0.67	+0 41 43.60	+43.78	− 2.07	−0.05	+0.01
95	Tauri	6.2	70 25 54.32	5025.71	+ 1.51	+1 47 17.38	+42.70	− 3.22	−0.34	+0.05
	i Tauri	5.1	71 39 27.08	5032.98	+ 7.83	−3 39 16.50	+41.64	− 4.50	−0.13	+0.02
318	B. Tauri	5.7	72 53 31.49	5024.09	− 1.27	−5 29 32.28	+45.41	− 0.93	−0.20	+0.03
99	Tauri	6.0	73 43 21.87	5024.41	+ 0.06	+1 15 10.13	+42.95	− 3.51	−0.24	+0.04
	k Tauri	5.6	73 55 3.40	5026.65	+ 2.44	+2 20 29.26	+40.05	− 6.43	−0.20	+0.03
	ι Tauri	4.7	74 41 27.33	5031.91	+ 7.23	−1 12 59.90	+40.87	− 5.72	−0.08	+0.01
330	B. Tauri	6.3	74 57 20.10	5028.19	+ 3.47	−1 33 23.74	+42.85	− 3.76	−0.28	+0.02
	m Tauri	5.0	75 24 43.42	5079.26	+54.24	−4 14 43.74	+43.81	− 2.87	−0.13	+0.01
	l Tauri	5.2	75 40 51.08	5019.67	− 5.14	−2 29 13.14	+41.77	− 4.93	−0.18	+0.01
105	Tauri	6.0	75 49 17.20	5025.09	+ 0.43	−1 12 33.14	+45.94	− 0.78	−0.22	+0.02
	n Tauri	5.1	78 28 40.40	5026.82	+ 2.22	−1 1 34.91	+38.48	− 8.48	−0.14	+0.01
111	Tauri	5.1	79 22 0.44	5048.95	+24.08	−5 48 41.10	+44.37	− 2.65	−0.14	+0.01
115	Tauri	5.3	80 4 0.75	5026.89	+ 2.10	−5 16 21.30	+44.77	− 2.28	−0.17	+0.01
117	Tauri	6.0	80 13 51.05	5026.81	+ 2.00	−6 0 17.76	+39.16	− 7.91	−0.30	+0.02
	o Tauri	4.8	80 24 6.19	5025.39	+ 0.80	−1 18 39.81	+46.08	− 1.00	−0.10	+0.01
118	Tauri	5.4	80 57 8.62	5026.32	+ 1.86	+1 52 41.46	+43.13	− 3.97	−0.17	+0.01
119	Tauri	4.9	81 18 3.09	5025.70	+ 1.02	−4 42 19.37	+46.69	− 0.42	−0.07	+0.01
120	Tauri	5.6	81 36 38.01	5026.22	+ 1.56	−4 46 26.98	+47.09	− 0.03	−0.16	+0.01
121	Tauri	5.1	82 18 6.83	5025.71	+ 1.19	+0 42 3.13	+43.94	− 3.19	−0.17	+0.01
107	B. Aurigæ	6.5	82 33 46.20	5022.35	− 2.12	+4 19 0.32	+39.64	− 7.50	−0.30	+0.02
	ζ Tauri	3.0	82 41 25.26	5025.18	+ 0.63	−2 12 51.55	+43.91	− 3.23	+0.12	−0.01
112	B. Aurigæ	5.7	82 48 11.66	5023.82	− 0.67	+3 34 3.20	+43.22	− 3.92	−0.20	+0.02
125	Tauri	5.1	83 20 41.02	5026.77	+ 2.25	+2 31 9.85	+44.10	− 3.04	−0.11	+0.01
126	Tauri	4.8	83 23 27.21	5026.69	+ 2.15	−6 51 3.24	+45.19	− 1.95	−0.11	+0.01
130	Tauri	5.6	84 53 58.78	5024.99	+ 0.57	−5 41 48.31	+46.21	− 0.92	−0.18	+0.01
132	Tauri	5.0	85 24 28.96	5024.52	− 0.04	+1 8 0.22	+44.81	− 2.31	−0.13	+0.01
406	B. Tauri	5.6	85 54 19.65	5023.00	− 1.70	+4 31 27.28	+48.24	+ 1.14	−0.19	+0.02
136	Tauri	4.6	86 25 24.38	5026.37	+ 1.66	+4 9 44.96	+45.01	− 2.07	−0.06	0.00

$\Delta_2 L = +(1''.11 + 0''.20 \tan B \sin (L + 16°)) T^2$; $\Delta_2 B = +0''.20\, T^2 \cos (L + 16°)$.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
χ′ Orionis	4.5	86 35 39.26	5006.46	−17.93	−3 10 22.30	+38.93	− 8.15	−0.08	0.00
57 Orionis	5.8	86 42 50.04	5024.70	+ 0.34	−3 42 13.73	+45.73	− 1.34	−0.23	0.00
139 Tauri	4.7	87 27 16.17	5024.70	+ 0.03	+2 29 45.62	+46.36	− 0.67	−0.13	0.00
141 Tauri	6.3	88 17 51.58	5023.20	− 1.26	−1 3 23.19	+45.89	− 1.09	−0.32	0.00
64 Orionis	5.1	88 43 14.75	5026.18	+ 1.93	−3 45 54.17	+44.86	− 2.09	−0.13	0.00
χ² Orionis	4.7	88 49 38.03	5025.80	+ 1.52	−3 19 1.50	+46.64	− 0.30	−0.10	0.00
1 Geminorum	4.1	88 51 8.15	5024.77	+ 0.25	−0 11 15.99	+36.05	−10.88	−0.04	0.00
2 Geminorum	6.9	89 27 56.22	5025.93	+ 1.38	+0 11 20.94	+45.82	− 1.06	−0.38	0.00
3 Geminorum	5.6	90 8 36.77	5026.38	+ 1.88	−0 19 34.56	+46.90	+ 0.07	−0.30	0.00
4 Geminorum	6.7	90 19 18.82	5024.25	− 0.24	−0 26 19.26	+45.66	− 1.14	−0.32	0.00
5 Geminorum	5.9	90 31 56.34	5026.23	+ 1.60	+0 59 24.50	+40.69	− 6.09	−0.32	0.00
68 Orionis	5.7	90 44 21.68	5025.90	+ 1.75	−3 38 17.28	+45.52	− 1.24	−0.19	0.00
6 Geminorum	6.3	90 44 32.68	5025.49	+ 1.01	−0 31 10.66	+45.47	− 1.29	−0.32	0.00
κ Aurigæ	4.4	91 16 22.13	5019.94	− 5.27	+6 5 43.07	+20.35	−26.36	−0.06	0.00
η Geminorum	3.2	91 20 40.95	5019.12	− 5.31	−0 54 25.22	+44.98	− 1.72	+0.10	0.00
71 Orionis	5.1	91 25 32.10	5015.55	− 8.50	−4 14 56.75	+27.11	−19.58	−0.13	0.00
8 Geminorum	6.1	91 38 0.23	5023.44	− 1.16	+0 33 52.50	+44.08	− 2.59	−0.30	0.00
9 Geminorum	6.2	91 47 25.90	5025.13	+ 0.56	+0 20 22.67	+45.84	− 0.80	−0.34	0.00
μ Geminorum	3.2	93 12 18.59	5031.20	+ 6.79	−0 50 5.44	+35.23	−11.24	+0.10	0.00
16 Geminorum	6.2	94 27 24.55	5021.41	− 2.68	−2 48 13.91	+45.63	− 0.65	−0.34	0.00
ν Geminorum	4.0	94 42 31.01	5023.43	− 0.61	−3 4 29.73	+44.62	− 1.62	0.00	0.00
21 Geminorum	7.2	95 37 42.93	5025.93	+ 2.35	−5 27 32.31	+49.65	+ 3.56	−0.36	0.00
49 Aurigæ	5.1	95 41 41.57	5025.40	+ 0.03	+4 48 8.19	+43.41	− 2.67	−0.11	0.00
γ Geminorum	1.9	97 0 32.74	5028.27	+ 5.04	−6 45 35.47	+41.30	− 4.54	+0.24	0.00
ε Geminorum	3.2	97 50 40.20	5024.89	− 0.06	+2 3 6.06	+43.86	− 1.81	+0.10	0.00
26 Geminorum	5.2	98 2 55.52	5025.47	+ 2.07	−5 26 12.62	+36.48	− 9.14	−0.13	−0.01
d Geminorum	5.2	99 51 49.06	5025.04	+ 0.78	−1 9 43.05	+40.80	− 4.43	−0.14	−0.01
ω Geminorum	5.2	102 6 40.02	5024.48	− 0.45	+1 31 25.86	+44.65	− 0.03	−0.16	−0.01
ζ Geminorum	3.8	102 53 47.43	5023.80	− 0.17	−2 3 25.77	+43.73	− 0.73	+0.02	0.00
47 Geminorum	5.6	103 49 15.69	5024.91	− 0.88	+4 22 52.64	+38.96	− 5.25	−0.18	−0.02
48 Geminorum	5.8	104 23 37.70	5024.31	− 0.72	+1 42 13.22	+39.84	− 4.20	−0.22	−0.02
52 Geminorum	6.1	104 48 21.04	5031.44	+ 6.15	+2 31 12.69	+35.96	− 7.95	−0.28	−0.02
δ Geminorum	3.3	106 25 33.52	5023.32	− 1.15	−0 11 44.49	+41.79	− 1.62	+0.04	0.00
λ Geminorum	3.7	106 41 13.55	5019.13	− 3.56	−5 39 4.75	+38.35	− 4.98	+0.05	0.00
56 Geminorum	5.2	107 3 39.06	5018.14	− 5.85	−1 39 37.22	+39.94	− 3.27	−0.12	−0.01
63 Geminorum	5.3	108 15 15.08	5021.09	− 3.28	−0 28 13.92	+31.19	−11.62	−0.16	−0.03
υ Geminorum	4.3	109 14 59.65	5025.92	− 0.47	+5 12 10.77	+31.33	−11.13	−0.02	0.00
176 B. Geminorum	6.3	110 10 55.10	5031.20	+ 5.64	+2 46 57.39	+40.11	− 2.01	−0.28	−0.04
67 Geminorum	6.7	110 28 37.07	5021.06	− 1.22	−6 0 22.29	+41.77	− 0.24	−0.32	−0.05
68 Geminorum	5.2	110 29 39.68	5021.71	− 0.64	−5 48 47.36	+39.48	− 2.53	−0.12	−0.02
c Geminorum	5.5	111 15 13.16	5024.47	− 1.76	+4 24 48.71	+38.56	− 3.16	−0.16	−0.03
κ Geminorum	3.6	111 34 18.80	5024.79	− 0.93	+3 3 49.51	+35.35	− 6.25	+0.05	+0.01
f Geminorum	5.3	111 34 53.54	5022.78	− 0.29	−3 45 40.51	+41.98	+ 0.39	−0.14	−0.02
82 Geminorum	6.3	112 43 22.64	5023.94	− 1.39	+1 59 33.77	+40.78	− 0.36	−0.30	−0.04
g Geminorum	5.0	112 59 52.72	5017.78	− 5.67	−2 39 43.72	+33.63	− 7.40	−0.13	−0.02
φ Geminorum	4.9	113 9 0.49	5024.78	− 2.11	+5 45 49.32	+37.86	− 3.10	−0.11	−0.02
85 Geminorum	5.2	114 57 20.21	5023.44	− 0.71	−0 53 45.35	+35.71	− 4.51	−0.16	−0.03
ω Cancri	6.1	115 3 44.02	5027.10	+ 0.52	+4 44 31.96	+39.83	− 0.31	−0.23	−0.04
4 Cancri	6.2	115 18 9.03	5024.76	− 1.72	+4 28 53.24	+40.41	+ 0.36	−0.26	−0.04
1 Cancri	6.0	116 3 37.95	5020.17	− 2.21	−4 51 2.29	+34.79	− 4.94	−0.23	−0.04
5 Cancri	5.9	116 59 34.19	5023.29	+ 0.57	−3 59 7.42	+39.38	+ 0.07	−0.29	−0.05
μ Cancri	5.5	117 22 56.19	5029.43	+ 4.29	+1 20 17.55	+31.44	− 7.69	−0.16	−0.03
ζ Cancri	4.6	119 14 40.91	5033.24	+ 9.81	−2 16 42.07	+27.22	−11.04	−0.12	−0.03
λ Cancri	5.9	119 43 15.00	5025 81	− 0.85	+4 21 54.95	+34.98	− 3.05	−0.20	−0.04
d¹ Cancri	5.7	121 40 51.50	5019.50	− 4.52	−1 1 2.82	+32.81	− 4.24	−0.23	−0.05
d² Cancri	6.2	122 33 32.78	5008.55	−14.88	−2 7 22.33	+17.35	−19.25	−0.26	−0.06
η Cancri	5.6	123 18 51.88	5023.31	− 2.04	+1 33 31.53	+30.04	− 6.16	−0.18	−0.03
θ Cancri	5.5	123 38 10.11	5020.31	− 3.81	−0 46 48.56	+28.10	− 7.94	−0.22	−0.05
29 Cancri	5.9	123 53 9.00	5020.16	− 1.86	−4 43 23.07	+33.22	− 2.68	−0.23	−0.05
38 Cancri	6.7	125 4 21.36	5023.56	− 1.70	+1 19 42.56	+34.69	− 0.58	−0.32	−0.07
39 Cancri	6.5	125 6 14.18	5022.13	− 3.26	+1 34 25.93	+32.76	− 2.49	−0.30	−0.07
98 B. Cancri	6.6	125 9 49.21	5025.09	− 0.05	+1 6 23.88	+32.22	− 3.00	−0.31	−0.07
102 B. Cancri	6.5	125 15 0.30	5018.87	− 6.35	+1 15 47.08	+32.47	− 2.71	−0.30	−0.07
ε Cancri	6.3	125 18 1.88	5024.92	− 0.24	+1 8 49.89	+32.26	− 2.88	−0.28	−0.06
42 Cancri	6.7	125 19 1.89	5023.76	− 1.50	+1 19 55.18	+33.49	− 1.64	−0.32	−0.07

The above longitudes and latitudes include the magnitude equation.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
107 B. Cancri	6.7	125 24 9.75	5022.94	− 2.26	+1 12 39.11	+32.73	− 2.36	−0.32	−0.07
γ Cancri	4.7	125 26 50.14	5017.79	− 8.50	+3 10 43.69	+28.37	− 6.69	−0.05	−0.02
δ Cancri	4.1	126 37 33.22	5029.53	+ 4.96	+0 4 20.92	+10.90	−23.50	−0.04	−0.01
A^2 Cancri	5.7	128 45 6.92	5015.80	− 5.44	−5 37 15.48	+25.83	− 7.35	−0.22	−0.05
o^1 Cancri	5.1	130 17 13.27	5028.50	+ 5.08	−1 51 6.77	+35.97	+ 3.70	−0.14	−0.04
o^2 Cancri	5.7	130 17 35.13	5028.91	+ 5.33	−1 34 51.71	+36.21	+ 3.94	−0.19	−0.05
68 Cancri	7.1	130 49 40.16	5022.31	− 2.31	+0 8 23.82	+31.49	− 0.46	−0.42	−0.11
60 Cancri	5.7	131 0 34.63	5020.44	− 0.75	−5 29 24.94	+29.66	− 2.17	−0.20	−0.05
α Cancri	4.3	131 32 49.16	5025.99	+ 4.58	−5 5 32.66	+28.49	− 3.03	−0.04	−0.01
κ Cancri	5.0	134 4 35.03	5019.57	− 1.40	−5 34 54.50	+28.18	− 1.75	−0.12	−0.03
π Cancri	5.6	134 33 22.97	5021.12	− 2.80	−0 57 35.71	+27.96	− 1.67	−0.19	−0.05
83 Cancri	6.6	134 34 54.13	5019.55	− 6.23	+1 57 8.06	+13.38	−16.24	−0.31	−0.08
222 B. Cancri	6.3	136 12 12.14	5028.55	+ 6.67	−4 2 54.18	+29.91	+ 1.35	−0.28	−0.07
8 Leonis	5.9	139 4 40.23	5025.67	− 0.29	+2 5 50.66	+24.98	− 1.66	−0.23	−0.07
ω Leonis	5.5	139 26 53.72	5026.43	+ 5.70	−5 33 58.34	+26.99	+ 0.60	−0.19	−0.06
ξ Leonis	5.0	139 33 22.68	5016.18	− 6.20	−3 9 42.64	+15.47	−10.85	−0.14	−0.05
h Leonis (pr.)	5.2	140 3 46.95	5021.89	+ 0.57	−4 39 57.87	+24.78	− 1.19	−0.17	−0.05
ψ Leonis	5.6	141 23 30.72	5024.80	+ 0.03	+0 20 24.68	+24.08	− 0.97	−0.20	−0.06
o Leonis	3.7	142 9 32.57	5009.57	−12.31	−3 45 49.63	+16.82	− 7.69	+0.02	+0.01
18 Leonis	5.8	142 44 9.98	5022.33	− 1.12	−1 31 58.14	+24.61	+ 0.50	−0.25	−0.07
ν Leonis	5.0	145 14 38.97	5021.57	− 3.00	+0 2 36.04	+18.33	− 3.98	−0.16	−0.05
η Leonis	3.6	145 48 34.33	5025.22	− 2.86	+4 51 25.00	+20.40	− 1.50	+0.05	+0.02
83 B. Leonis	5.9	146 2 16.13	5011.08	−10.96	−3 24 24.28	+19.57	− 2.17	−0.24	−0.07
π Leonis	5.0	147 13 15.50	5018.51	− 3.13	−3 55 8.50	+16.89	− 3.97	−0.12	−0.04
α Leonis	1.4	147 44 40.27	5001.76	−23.11	+0 27 35.94	+11.72	− 8.76	+0.31	+0.09
A Leonis	4.6	148 19 20.38	5017.95	− 5.52	−1 25 26.30	+10.83	− 9.22	−0.07	−0.02
37 Leonis	5.5	149 0 10.23	5025.36	− 1.29	+2 49 22.71	+17.54	− 2.00	−0.23	−0.08
14 Sextantis	6.3	149 36 29.69	5017.25	− 3.03	−5 37 45.89	+17.74	− 1.35	−0.35	−0.12
42 Leonis	6.1	149 43 10.82	5026.59	− 1.29	+4 26 14.91	+15.59	− 3.42	−0.26	−0.09
16 Sextantis	6.8	149 59 0.40	5020.51	− 0.32	−4 53 27.39	+17.05	− 1.76	−0.37	−0.13
19 Sextantis	5.9	151 22 20.60	5014.95	− 4.97	−6 1 48.16	+15.20	− 2.55	−0.24	−0.08
167 B. Leonis	7.1	151 31 37.90	5021.75	− 6.20	+4 27 58.52	+12.04	− 5.60	−0.37	−0.13
46 Leonis	5.8	152 22 4.51	5024.05	− 4.00	+4 34 32.46	+17.79	+ 0.80	−0.20	−0.07
ρ Leonis	3.8	154 17 41.42	5024.24	− 0.40	+0 8 37.48	+14.98	− 0.52	0.00	0.00
49 Leonis	5.7	155 2 59.81	5020.63	− 3.70	−0 15 41.61	+12.35	− 2.57	−0.20	−0.07
k Leonis	5.5	155 33 28.82	5019.56	− 9.63	+5 55 38.59	+ 3.75	−10.77	−0.20	−0.07
48 Leonis	5.2	155 37 41.67	5011.37	−11.71	−1 51 37.03	+14.83	+ 0.36	−0.14	−0.05
37 Sextantis	6.3	158 26 31.69	5023.52	+ 0.06	−1 20 46.80	+ 7.91	− 4.33	−0.26	−0.10
34 Sextantis	6.6	158 41 53.77	5011.88	− 9.26	−4 15 26.74	+11.32	− 0.72	−0.44	−0.17
c Leonis	5.1	161 54 50.36	5020.47	− 3.89	−0 12 30.72	+ 5.16	− 4.31	−0.13	−0.05
χ Leonis	4.6	162 25 36.38	4995.12	−30.50	+1 20 42.24	− 8.05	−17.11	−0.08	−0.03
55 Leonis	6.1	162 48 40.19	5030.64	+10.69	−5 38 51.25	+11.70	+ 2.96	−0.24	−0.09
d Leonis	5.1	162 49 31.76	5023.92	+ 1.42	−2 31 12.78	+ 6.89	− 1.83	−0.12	−0.05
p^4 Leonis	5.6	164 56 44.33	4989.77	−31.96	−3 25 53.25	−15.04	−22.05	−0.12	−0.05
ι Leonis	4.1	165 27 43.92	5046.88	+17.36	+6 6 9.94	+ 4.92	− 1.67	+0.01	+0.01
σ Leonis	4.2	166 36 51.36	5017.94	− 7.98	+1 41 48.47	+ 0.87	− 4.78	−0.01	0.00
p^5 Leonis	5.3	167 18 26.57	5016.88	− 3.85	−4 38 14.31	+ 3.10	− 1.98	−0.16	−0.08
τ Leonis	5.2	169 25 0.50	5025.88	+ 1.80	−0 33 20.15	+ 2.33	− 1.02	−0.12	−0.05
89 Leonis	5.7	170 49 1.07	5012.25	−12.50	+0 16 20.40	−14.45	−16.65	−0.20	−0.08
ξ Virginis	4.8	171 14 10.71	5037.03	+ 7.45	+6 6 51.40	+ 1.40	− 0.46	−0.11	−0.04
ν Virginis	4.2	172 3 39.83	5033.76	+ 5.45	+4 35 36.30	−16.76	−17.94	−0.02	−0.01
e Leonis	5.1	172 17 0.19	5022.67	+ 2.84	−5 42 12.42	+ 1.29	+ 0.29	−0.13	−0.05
υ Leonis	4.5	172 56 38.45	5020.41	− 1.61	−3 2 49.16	+ 4.00	+ 3.55	−0.06	−0.02
β Virginis	3.8	175 2 12.32	5103.93	+78.83	+0 41 35.28	+ 2.93	+ 4.20	+0.04	+0.03
b Virginis	5.2	176 26 15.67	5026.58	− 0.71	+3 21 0.03	− 3.98	− 1.56	−0.14	−0.06
13 B. Virginis	5.9	177 58 48.01	5020.59	+ 0.82	−5 46 53.42	− 2.64	+ 1.04	−0.23	−0.09
c Virginis	5.1	181 15 57.00	5004.24	−24.43	+5 4 19.19	−24.83	−18.46	−0.14	−0.06
13 Virginis	5.9	182 30 1.45	5028.86	+ 3.41	+1 8 9.09	− 8.18	− 0.80	−0.28	−0.11
η Virginis	4.0	182 44 21.55	5021.78	− 3.86	+1 22 13.64	−12.22	− 4.65	−0.14	−0.06
γ Virginis (mean)	2.9	188 4 4.36	4976.18	−50.59	+2 48 15.46	−33.04	−21.18	+0.12	+0.05
q Virginis	5.3	189 23 41.03	5012.31	− 7.99	−5 19 55.39	−15.94	− 3.03	−0.20	−0.08
28 Virginis	7.2	190 29 3.96	5025.33	+ 2.96	−2 44 28.52	−17.51	− 3.74	−0.38	−0.16
k Virginis	5.7	193 6 44.05	5022.82	− 3.54	+2 21 57.73	−17.76	− 1.93	−0.23	−0.09
48 Virginis	6.5	194 2 2.34	5023.23	− 3.54	+2 54 43.31	−21.02	− 4.48	−0.30	−0.11
θ Virginis	4.4	196 8 35.51	5023.32	− 2.54	+1 45 9.13	−23.52	− 5.37	−0.05	−0.02

$\Delta_2 L = +(1''.11 + 0''.20 \tan B \sin (L+16°))\, T^2$; $\Delta_2 B = +0''.20\, T^2 \cos (L+16°)$.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
49 Virginis	5.2	197 39 3.38	5023.61	+ 1.53	−3 15 10.21	− 20.19	− 0.90	−0.14	−0.06
58 Virginis	7.2	199 45 27.36	5015.59	− 7.33	−2 10 59.83	− 23.32	− 2.46	−0.36	−0.14
l Virginis	4.8	201 29 47.12	5018.89	− 7.92	+3 8 5.94	− 30.07	− 7.94	−0.11	−0.04
α Virginis	1.2	201 44 55.61	5020.38	− 2.67	−2 2 35.29	− 26.89	− 4.57	+0.34	+0.04
80 Virginis	5.6	202 0 11.98	5026.26	− 1.35	+4 15 7.25	− 14.92	+ 7.58	−0.22	−0.08
i Virginis	5.7	202 40 24.76	5009.86	−12.27	−3 20 23.00	− 30.42	− 7.44	−0.18	−0.07
69 Virginis	4.9	204 3 20.19	5007.91	−12.13	−6 18 30.15	− 27.47	− 3.50	−0.11	−0.04
m Virginis	5.2	204 37 3.02	5014.43	−11.31	+1 43 14.95	− 25.29	− 0.92	−0.16	−0.05
75 Virginis	5.6	205 2 32.77	5013.88	− 6.95	−5 15 35.64	− 26.96	− 2.30	−0.20	−0.07
88 Virginis	6.5	205 29 43.52	5024.02	− 3.34	+4 3 23.68	− 29.80	− 4.82	−0.36	−0.14
85 Virginis	6.1	208 3 15.01	5018.76	− 2.69	−4 31 30.31	− 31.43	− 4.69	−0.25	−0.08
607 B. Virginis	6.8	210 23 47.16	5024.56	+ 1.28	−1 53 20.46	− 27.95	+ 0.36	−0.34	−0.12
94 Virginis	6.6	210 23 54.42	5025.21	− 1.74	+3 40 42.77	− 28.01	+ 0.30	−0.34	−0.12
95 Virginis	5.4	210 38 39.55	5012.66	−14.05	+3 19 9.25	− 32.44	− 3.98	−0.20	−0.07
κ Virginis	4.4	212 24 0.91	5022.72	− 3.69	+2 55 11.78	− 16.88	+ 12.73	−0.04	−0.01
40 H. Virginis	5.1	213 56 32.14	5023.54	+ 0.86	−2 55 22.46	− 13.77	− 1.19	−0.13	−0.05
λ Virginis	4.5	214 51 31.10	5020.83	− 4.01	+0 30 10.78	− 30.37	+ 0.78	−0.07	−0.02
μ Libræ	5.4	222 4 29.04	5019.12	− 6.52	+2 2 55.17	− 40.32	− 4.97	−0.17	−0.05
13 Libræ	5.7	222 35 53.64	5020.88	− 6.11	+4 33 38.64	− 39.57	− 3.94	−0.23	−0.07
8 Libræ	5.4	222 56 3.10	5016.87	− 7.86	+0 22 52.31	− 46.01	− 10.20	−0.17	−0.05
α Libræ	2.7	222 59 29.60	5016.26	− 8.45	+0 21 8.11	− 46.50	− 10.65	+0.12	+0.04
10 Libræ	6.8	223 53 14.88	5019.75	− 3.84	−1 47 46.80	− 36.66	− 0.34	−0.29	−0.08
ν Libræ	5.3	226 40 39.74	5021.32	− 3.81	+1 12 48.46	− 42.65	− 4.91	−0.17	−0.04
26 Libræ	6.3	228 54 37.02	5022.10	− 2.55	+0 15 55.20	− 41.24	− 2.42	−0.30	−0.08
ι Libræ	4.3	228 54 41.09	5022.58	− 2.81	−1 50 37.37	− 45.14	− 6.33	−0.11	−0.03
25 Libræ	6.0	229 7 23.44	5019.86	− 3.91	−1 37 24.26	− 43.67	− 4.76	−0.30	−0.08
o Libræ	6.2	229 49 44.04	5027.79	+ 1.98	+2 48 29.77	− 36.18	+ 3.06	−0.24	−0.06
28 Libræ	6.2	230 27 53.62	5024.14	− 0.51	+0 16 48.22	− 45.98	− 6.46	−0.24	−0.06
ζ Libræ	5.6	232 55 22.24	5024.55	− 0.92	+2 15 2.25	− 44.20	− 3.61	−0.17	−0.04
γ Libræ	4.1	233 2 25.16	5032.87	+ 6.50	+4 24 7.50	− 38.35	+ 2.28	0.00	0.00
41 Libræ	5.3	234 52 33.04	5035.47	+10.86	+0 12 15.54	− 44.67	− 3.29	−0.20	−0.05
η Libræ	5.5	235 15 32.07	5023.96	− 2.13	+4 1 7.53	− 50.19	− 8.66	−0.18	−0.06
κ Libræ	5.0	235 39 48.58	5022.18	− 2.35	+0 0 10.63	− 53.16	− 11.48	−0.12	−0.03
42 Libræ	5.0	236 13 36.55	5021.13	− 1.84	−4 7 11.81	− 45.12	− 3.22	−0.12	−0.03
θ Libræ	4.4	237 46 28.83	5032.45	+ 6.68	+3 29 0.12	− 28.84	+ 13.63	−0.04	−0.01
λ Libræ	4.9	238 22 54.76	5023.18	− 1.38	+0 6 15.92	− 47.72	− 5.03	−0.12	−0.03
b Scorpii	4.7	239 1 53.85	5020.52	− 2.14	−5 28 5.87	− 47.89	− 4.99	−0.10	−0.02
49 Libræ	5.4	239 17 16.41	4972.61	−53.27	+4 1 12.97	− 94.12	− 51.12	−0.19	−0.04
A Scorpii	4.6	239 31 28.32	5021.10	− 1.78	−4 55 42.03	− 45.79	− 2.72	−0.08	−0.02
δ Scorpii	2.7	240 28 38.38	5023.05	− 0.84	−1 58 0.23	− 47.11	− 3.72	+0.18	+0.04
π Scorpii	3.0	240 50 46.96	5022.50	− 0.29	−5 27 20.58	− 48.50	− 5.00	+0.11	+0.03
β Scorpii	2.9	241 5 43.83	5023.84	− 1.01	+1 1 37.24	− 46.64	− 3.06	+0.12	+0.03
ω^1 Scorpii	4.3	241 34 30.60	5023.31	− 1.29	+0 14 24.26	− 47.98	− 4.25	−0.01	0.00
ω^2 Scorpii	4.6	241 44 52.06	5029.82	+ 5.27	+0 4 14.92	− 48.91	− 5.13	−0.07	−0.02
ν Scorpii	3.9	242 32 57.63	5023.48	− 1.54	+1 39 10.52	− 48.46	− 4.43	−0.06	−0.02
65 B. Scorpii	5.5	242 55 57.12	5035.17	+12.17	−5 15 41.96	− 39.37	+ 4.77	−0.18	−0.04
83 B. Scorpii	6.7	243 17 19.15	5012.59	−11.89	−0 11 6.14	− 45.07	− 0.83	−0.32	−0.04
58 G. Scorpii	6.2	244 19 59.95	5025.23	+ 0.38	+1 12 1.69	− 45.26	− 0.74	−0.26	−0.04
19 Scorpii	4.9	245 20 37.65	5022.51	− 1.34	−2 38 7.16	− 46.33	− 1.54	−0.08	−0.02
σ Scorpii	3.0	245 42 21.12	5022.69	− 0.82	−4 1 2.94	− 48.98	− 4.10	+0.12	+0.02
χ Ophiuchi	4.9	245 53 4.53	5024.79	− 0.55	+3 14 36.70	− 47.26	− 2.32	−0.12	−0.02
ρ Ophiuchi	4.7	246 20 34.82	5022.24	− 1.87	−1 44 13.45	− 46.12	− 1.08	−0.08	−0.02
22 Scorpii	4.8	247 38 41.64	5023.58	− 0.22	−3 13 15.97	− 47.05	− 1.70	−0.07	−0.01
α Scorpii	1.3	247 40 6.65	5023.15	− 0.36	−4 32 59.92	− 48.29	− 2.94	+0.35	+0.04
24 Scorpii	5.0	249 12 33.04	5023.02	− 2.41	+4 27 10.34	− 46.43	− 0.74	−0.12	−0.02
τ Scorpii	2.8	249 21 47.80	5022.12	− 1.18	−6 6 0.86	− 49.37	− 3.65	+0.13	+0.02
18 Ophiuchi	6.8	251 58 24.19	5024.35	+ 0.17	−2 8 50.26	− 50.33	− 4.13	−0.32	−0.05
24 Ophiuchi	5.5	253 24 23.82	5025.06	+ 0.60	−0 28 58.32	− 49.81	− 3.40	−0.19	−0.02
29 Ophiuchi	6.4	254 8 12.06	5021.85	− 3.20	+3 52 54.97	− 48.92	− 2.40	−0.30	−0.02
36 Ophiuchi	5.4	257 56 2.41	4984.87	−39.38	−3 28 50.94	−167.62	−120.71	−0.17	−0.02
157 B. Ophiuchi	6.7	258 20 57.38	5034.34	+ 9.88	−0 57 28.25	− 53.10	− 6.16	−0.29	−0.02
θ Ophiuchi	3.3	259 18 1.94	5023.82	− 0.60	−1 49 22.33	− 50.64	− 3.63	+0.07	+0.01
43 Ophiuchi	5.4	259 48 20.03	5024.30	+ 0.03	−4 56 23.63	− 51.02	− 3.98	−0.19	−0.02
191 B. Ophiuchi	6.3	259 57 14.12	5025.69	+ 1.21	−1 1 32.80	− 45.29	+ 1.76	−0.28	−0.02
44 Ophiuchi	4.1	260 14 19.66	5024.12	− 0.38	−0 56 5.50	− 60.84	− 13.78	−0.06	0.00

The above longitudes and latitudes include the magnitude equation.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
52 Ophiuchi	6.4	262 11 2.98	5023.60	− 0.95	+1 17 35.21	−47.59	− 0.46	−0.30	−0.02
58 Ophiuchi	4.8	264 3 31.82	5016.04	− 8.47	+1 43 20.67	−52.70	− 5.56	−0.10	0.00
X Sagittarii	4.4–5.4	265 8 50.94	5024.96	+ 0.33	−4 24 4.22	−48.65	− 1.53	−0.08	0.00
W Sagittarii	4.3–5.1	269 0 10.37	5025.97	+ 0.95	−6 7 32.67	−48.45	− 1.52	+0.16	0.00
μ Sagittarii	4.0	271 7 8.75	5023.67	− 0.60	+2 21 41.35	−46.87	− 0.15	−0.01	0.00
16 Sagittarii	5.9	271 28 33.45	5024.86	+ 0.67	+3 1 24.99	−46.86	− 0.17	−0.26	0.00
66 B. Sagittarii	4.7	271 55 56.52	5024.95	− 0.02	−3 38 49.05	−45.14	+ 1.49	−0.08	0.00
67 B. Sagittarii	6.4	272 7 23.20	5018.64	− 6.16	−2 12 46.93	−52.66	− 6.05	−0.29	0.00
δ Sagittarii	2.9	272 29 4.90	5028.30	+ 2.94	−6 27 6.16	−50.02	− 3.46	+0.14	0.00
21 Sagittarii	5.0	273 50 44.21	5024.07	− 0.05	+2 47 14.81	−48.77	− 2.39	−0.12	0.00
λ Sagittarii	2.9	274 13 28.85	5019.55	− 5.30	−2 6 31.38	−66.01	−19.69	+0.11	0.00
24 Sagittarii	5.7	275 38 23.99	5024.23	− 0.44	−0 48 2.46	−48.06	− 1.97	−0.23	0.00
110 B. Sagittarii	7.2	276 16 25.53	5025.81	+ 2.00	+3 56 1.45	−48.22	− 2.25	−0.38	0.00
121 B. Sagittarii	5.9	276 58 59.71	5015.56	− 8.57	+2 6 24.27	−59.19	−13.34	−0.23	0.00
φ Sagittarii	3.3	278 5 3.52	5029.86	+ 4.51	−3 56 5.41	−46.56	− 0.94	+0.08	−0.01
28 Sagittarii	5.6	278 36 23.61	5026.95	+ 2.56	+0 38 11.92	−44.73	+ 0.78	−0.19	+0.02
29 Sagittarii	5.3	279 33 2.43	5024.86	+ 0.93	+2 37 53.22	−42.33	+ 2.97	−0.18	+0.01
σ Sagittarii	2.1	280 17 24.73	5024.28	− 1.06	−3 25 41.96	−52.55	− 7.42	+0.20	−0.02
33 Sagittarii	5.8	280 28 2.02	5022.96	− 1.21	+1 30 43.90	−46.49	− 1.40	−0.24	+0.02
ξ Sagittarii	3.7	281 21 19.47	5027.05	+ 2.95	+1 40 50.27	−47.41	− 2.54	+0.06	0.00
τ Sagittarii	3.5	282 44 33.79	5017.14	− 8.77	−5 3 37.10	−69.10	−24.60	+0.06	0.00
ο Sagittarii	3.9	282 53 48.10	5030.62	+ 6.33	+0 52 52.56	−51.48	− 7.02	+0.01	0.00
187 B. Sagittarii	6.4	283 48 42.86	5027.93	+ 4.48	+3 47 54.29	−50.29	− 6.08	−0.29	+0.02
π Sagittarii	3.0	284 9 27.86	5022.99	− 1.12	+1 27 24.66	−47.59	− 3.49	+0.11	−0.02
d Sagittarii	5.1	286 15 18.36	5021.18	− 2.30	+3 16 37.63	−44.86	− 1.39	−0.11	+0.01
234 B. Sagittarii	5.9	286 34 58.37	5024.90	− 1.50	−5 46 4.29	−41.45	+ 1.91	−0.23	+0.02
226 B. Sagittarii	6.4	287 8 59.57	5023.93	+ 0.35	+2 52 13.22	−42.28	+ 0.90	−0.30	+0.02
χ Sagittarii	4.9	287 14 22.73	5029.01	+ 3.66	−2 28 6.80	−50.00	− 6.85	−0.13	+0.02
45 Sagittarii	6.0	287 19 46.15	5031.22	+ 7.95	+3 47 1.87	−52.43	− 9.31	−0.24	+0.03
ρ Sagittarii	4.0	287 21 25.73	5020.46	− 2.66	+4 14 27.22	−41.21	+ 1.90	+0.01	0.00
49 Sagittarii	5.5	287 22 15.63	5022.95	− 2.23	−1 56 16.14	−42.66	+ 0.45	−0.18	+0.02
50 Sagittarii	5.5	287 52 31.65	5027.05	+ 2.58	+0 11 49.16	−43.17	− 0.24	−0.18	+0.02
h Sagittarii	4.7	289 44 58.65	5031.28	+ 5.57	−3 14 25.94	−45.87	− 3.60	−0.05	+0.01
e Sagittarii	5.2	292 33 46.98	5027.99	+ 5.53	+5 9 57.78	−43.64	− 2.45	−0.12	+0.02
f Sagittarii	5.1	292 50 0.27	5008.70	−15.26	+1 25 36.72	−47.42	− 6.32	−0.13	+0.02
ω Sagittarii	4.8	293 44 46.76	5047.50	+20.72	−5 24 24.04	−36.47	+ 4.25	−0.12	+0.02
57 Sagittarii	6.0	294 18 46.03	5022.88	− 0.86	+1 52 44.11	−46.10	− 5.61	−0.26	+0.04
A Sagittarii	4.9	294 27 42.92	5029.21	+ 2.37	−5 26 27.98	−37.17	+ 3.25	−0.12	+0.02
σ Capricorni	5.5	300 34 57.80	5023.91	− 0.39	+0 28 15.36	−38.14	− 0.53	−0.19	+0.04
16 B. Capricorni	6.2	301 53 45.77	5025.74	+ 3.58	+4 36 50.32	−37.31	− 0.36	−0.23	+0.05
β Capricorni	3.2	301 57 7.87	5026.62	+ 4.45	+4 36 15.08	−37.26	− 0.35	+0.07	−0.02
π Capricorni	5.1	302 37 11.26	5024.50	+ 0.44	+0 54 54.68	−36.93	− 0.36	−0.14	+0.03
ρ Capricorni	5.0	303 4 18.69	5021.65	− 2.24	+1 12 50.43	−37.85	− 1.52	−0.12	+0.03
υ Capricorni	5.3	305 34 7.90	5021.80	− 2.60	+0 14 16.73	−35.01	− 0.02	−0.16	+0.05
17 Capricorni	5.8	306 4 41.57	5027.60	+ 1.17	−3 23 41.97	−36.43	− 1.72	−0.22	+0.07
19 Capricorni	5.7	309 0 27.04	5018.80	− 6.02	−0 29 8.60	−32.69	+ 0.35	−0.24	+0.06
20 Capricorni	6.2	309 47 23.80	5026.70	+ 1.05	−1 52 13.03	−34.98	− 2.41	−0.26	+0.07
21 Capricorni	6.5	310 30 10.80	5021.32	− 3.52	−0 30 42.94	−31.37	+ 0.77	−0.28	+0.07
η Capricorni	4.8	310 38 43.20	5021.57	− 4.76	−2 58 39.96	−35.53	− 3.47	−0.14	+0.04
χ Capricorni	5.3	311 11 15.34	5027.31	+ 0.01	−4 32 22.07	−37.93	− 6.20	−0.16	+0.04
θ Capricorni	4.1	311 44 48.46	5029.94	+ 5.05	−0 34 10.50	−39.81	− 8.42	−0.04	+0.01
φ Capricorni	5.3	312 55 48.81	5027.31	− 0.05	−4 30 52.50	−30.69	− 0.03	−0.18	+0.04
ν Aquarii	4.4	314 17 59.76	5029.34	+ 7.86	+4 46 43.30	−32.77	− 2.98	−0.07	+0.01
29 Capricorni	5.5	314 36 12.83	5026.36	+ 2.28	+0 42 15.05	−29.86	− 0.26	−0.18	+0.04
33 Capricorni	5.3	314 46 34.65	5022.76	− 5.19	−5 18 37.93	−39.58	−10.10	−0.19	+0.05
35 Capricorni	6.0	315 21 17.62	5025.32	− 3.02	−5 52 2.82	−31.33	− 2.22	−0.24	+0.06
ι Capricorni	4.3	315 35 9.59	5028.55	+ 3.14	−1 21 16.95	−29.58	− 0.62	−0.05	+0.02
18 Aquarii	5.5	317 15 6.80	5030.73	+ 7.70	+2 15 50.85	−29.61	− 1.74	−0.17	+0.04
ε Capricorni	4.7	318 6 9.64	5027.89	+ 0.02	−4 57 53.17	−27.25	+ 0.05	−0.06	+0.02
73 B. Aquarii	6.8	318 18 34.85	5025.72	+ 1.48	+0 25 45.93	−31.08	− 3.92	−0.34	+0.10
143 B. Capricorni	6.1	319 25 21.87	5036.01	+ 7.66	−5 35 1.26	−33.18	− 6.77	−0.25	+0.07
κ Capricorni	4.8	319 32 37.26	5040.22	+12.39	−4 49 36.60	−31.18	− 4.85	−0.08	+0.03
γ Capricorni	3.7	319 41 18.48	5043.21	+16.94	−2 32 35.18	−33.82	− 7.59	+0.02	−0.01
44 Capricorni	6.0	321 6 59.22	5025.07	+ 0.09	−0 38 43.36	−22.74	+ 2.50	−0.22	+0.06
45 Capricorni	5.8	321 13 3.07	5023.42	− 1.84	−1 3 1.61	−24.74	+ 0.44	−0.19	+0.06

$\Delta_2 L = +(1''.11 + 0''.20 \tan B \sin (L+16°))\, T^2$; $\Delta_2 B = +0''.20\, T^2 \cos (L+16°)$.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
δ Capricorni	2.9	321 26 28.24	5040.46	+14.12	−2 34 34.32	−61.40	−36.39	+0.12	−0.04
c^1 Capricorni	5.3	323 19 13.02	5022.30	+ 0.77	+4 13 6.46	−23.14	+ 0.56	−0.14	+0.05
c^2 Capricorni	6.3	323 33 3.75	5022.92	+ 1.20	+3 55 54.14	−23.84	− 0.31	−0.26	+0.05
29 Aquarii (mean)	6.5	324 38 15.05	5029.20	+ 1.32	−4 38 9.44	−22.27	+ 0.48	−0.30	+0.09
ι Aquarii	4.4	326 37 26.68	5026.90	+ 0.85	−2 4 10.11	−28.20	− 6.90	−0.04	+0.01
e Aquarii	5.4	328 23 27.40	5028.03	+ 3.29	−0 16 28.18	−19.10	+ 0.90	−0.17	+0.06
40 Aquarii	7.1	328 54 26.96	5025.93	+ 0.76	−0 51 20.29	−21.39	− 1.77	−0.37	+0.13
42 Aquarii	5.5	329 21 5.11	5027.78	+ 1.75	−1 59 44.55	−18.99	+ 0.29	−0.20	+0.07
50 Aquarii	5.9	330 50 5.72	5032.16	+ 5.11	−3 19 9.70	−18.75	− 0.59	−0.24	+0.08
θ Aquarii	4.3	331 9 56.15	5032.02	+ 9.55	+2 43 0.16	−23.52	− 5.61	−0.04	+0.01
ρ Aquarii	5.3	331 56 2.18	5023.57	+ 0.86	+2 22 44.31	−18.56	− 1.24	−0.17	+0.06
σ Aquarii	4.8	333 17 36.84	5024.50	− 0.97	−1 13 13.16	−18.64	− 2.36	−0.10	+0.04
58 Aquarii	6.4	333 26 41.26	5031.33	+ 5.62	−1 31 29.09	−21.76	− 5.60	−0.29	+0.10
51 Aquarii	5.8	333 55 39.98	5021.89	+ 1.09	+4 48 23.95	−17.40	− 1.61	−0.22	+0.07
69 Aquarii	5.6	335 53 48.74	5031.89	+ 2.70	−5 54 47.58	−16.85	− 2.60	−0.19	+0.06
204 B. Aquarii	6.8	335 56 39.66	5042.97	+17.76	−0 51 47.23	−17.92	− 3.70	−0.34	+0.12
τ Aquarii	4.4	336 30 1.82	5026.67	− 2.33	−5 39 28.04	−16.38	− 2.60	−0.01	0.00
κ Aquarii	5.2	337 19 39.61	5010.30	−10.97	+4 7 8.76	−20.89	− 7.76	−0.18	+0.06
70 Aquarii	6.1	337 27 17.98	5031.79	+ 5.09	−2 44 34.99	−14.04	− 1.01	−0.28	+0.09
λ Aquarii	3.8	339 28 50.14	5026.42	+ 1.58	−0 23 0.06	− 8.26	+ 3.16	+0.02	−0.01
78 Aquarii	6.3	340 4 24.53	5021.29	− 3.42	−0 13 9.35	−12.67	− 1.73	−0.28	+0.10
82 Aquarii	6.4	342 8 34.12	5023.62	− 1.23	−0 23 47.64	−12.40	− 3.12	−0.34	+0.13
h Aquarii	5.4	342 18 14.68	5037.58	+11.69	−1 40 48.12	−12.25	− 3.10	−0.18	+0.07
ψ^1 Aquarii	4.5	344 11 56.30	5061.64	+33.86	−3 59 31.32	−22.50	−14.88	−0.06	+0.02
ψ^2 Aquarii	4.6	344 37 59.21	5029.54	+ 1.52	−4 16 47.28	− 8.14	− 0.88	−0.06	+0.02
ψ^3 Aquarii	5.2	344 42 14.23	5032.05	+ 3.63	−4 46 33.95	− 8.85	− 1.65	−0.13	+0.06
χ Aquarii	5.3	344 57 57.74	5024.25	− 2.59	−2 50 18.77	− 7.44	− 0.45	−0.14	+0.07
φ Aquarii	4.6	345 2 44.04	5019.89	− 5.48	−1 2 29.92	−25.71	−18.76	−0.02	+0.01
96 Aquarii	5.7	346 33 38.70	5042.24	+17.15	−0 41 19.58	−14.00	− 8.31	−0.20	+0.11
337 B. Aquarii	6.4	349 7 9.19	5033.51	+ 8.05	−1 7 48.64	−30.74	−27.13	−0.29	+0.12
κ Piscium	4.9	350 48 32.14	5024.91	+ 4.03	+4 26 17.94	−14.00	−11.80	−0.12	+0.05
9 Piscium	6.4	350 49 44.28	5024.32	+ 3.31	+4 16 55.58	− 6.79	− 4.60	−0.29	+0.12
15 Piscium	6.6	352 47 50.76	5043.72	+22.19	+3 38 32.46	−13.81	−13.24	−0.38	+0.16
16 Piscium	5.7	353 19 33.08	5013.10	− 7.91	+4 16 13.67	+ 9.47	+ 9.61	−0.19	+0.08
B.D.−1° 4485	7.3	354 12 8.65	5023.80	.....	+0 53 2.86	+ 0.58	.....	−0.40	+0.16
λ Piscium	4.6	354 30 8.96	5002.97	−18.75	+3 25 14.61	− 7.84	− 8.67	−0.08	+0.03
21 Piscium	5.6	355 54 59.22	5021.76	− 1.10	+2 2 7.85	− 1.15	− 3.14	−0.25	+0.10
30 Piscium	4.7	355 57 6.15	5031.79	+ 2.55	−5 42 35.10	− 3.16	− 5.18	−0.07	+0.03
19 Piscium	5.4	356 10 32.27	5015.31	− 5.47	+4 33 3.67	+ 2.42	+ 0.22	−0.14	+0.06
27 Piscium	5.1	356 11 14.82	5019.79	− 7.31	−3 7 46.42	− 1.79	− 4.00	−0.12	+0.05
33 Piscium	4.8	356 50 53.43	5032.16	+ 2.88	−5 46 14.28	+11.40	+ 8.65	−0.07	+0.03
29 Piscium	5.1	357 7 1.66	5027.72	+ 0.76	−2 57 34.66	+ 1.38	− 1.60	−0.13	+0.05
22 Piscium	5.8	357 13 47.27	5022.51	+ 0.85	+3 29 12.40	+ 1.53	− 1.54	−0.23	+0.09
4 Ceti	6.3	358 39 47.77	5029.84	+ 2.76	−3 6 32.46	+ 4.01	− 0.24	−0.29	+0.12
5 Ceti	6.3	358 48 41.28	5027.99	+ 0.94	−3 3 46.53	+ 5.43	+ 1.07	−0.28	+0.11

The above longitudes and latitudes include the magnitude equation.

Chapter VII.

TABLE OF THE POSITION ANGLES USED IN COMPUTING THE COEFFICIENTS OF THE EQUATIONS OF CONDITION.

The circumstances under which the present work has been completed prevent all the required data and numbers from being collected on a uniform plan. It is believed, however, that incomplete lists of the numbers will be useful in any revision of the work that may be hereafter undertaken. The data will at least be harmless.

The arrangement of the original work was that adopted in the Researches of 1878. Instead of the occultations being worked up in chronological order the more convenient plan was adopted of working up each series made in any one place by itself. The principal numbers entering into the computations of the parallax and their corrections were tabulated in the form of tabular exhibits of the equations. Afterwards the equations themselves were formed and arranged in chronological order.

For reasons which will be mentioned in the next chapter these tabular exhibits have been omitted in publishing the present work, and instead of them are given merely the most needful data for the coefficients of the conditional equations.

The following are the tabular numbers retained in the present connection. They are all so clear that no detailed explanation seems necessary.

ALTONA.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°					
1871, Nov. 18	ε Capricor.	225	207	223					

BERLIN.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
							°	°	°
1826, May 12	1 Cancri	226	236	222	1837, Feb. 17	λ Cancri	348	359	349
13	A^2 Cancri	272	286	270	Mar. 12	62 Tauri	228	219	232
July 27	53 Arietis	307	292	302	July 9	η Virginis	99	122	95
Sept. 21	43 Tauri	66	55	61	Aug. 18	10 Ceti	263	240	268
1828, Mar. 24	68 Geminor.	263	271	262	18	10 Ceti	75	52	80
24	67 Geminor.	310	318	308	Oct. 9	143 B. Capricor.	254	237	256
1830, Mar. 3	26 Geminor.	233	236	234	9	143 B. Capricor.	88	105	91
29	111 Tauri	98	94	98	Nov. 5	35 Capricor.	316	300	318
29	117 Tauri	300	296	301	1838, July 31	65 B. Scorpii	287	297	291
Apr. 28	1 Cancri	297	307	300	Sept. 8	ζ Arietis	255	240	259
Sept. 5	ν Piscium	313	292	310	Oct. 25	A Sagittarii	193	184	195
5	ν Piscium	49	28	46	Nov. 3	χ Tauri	213	203	216
Oct. 20	24 Scorpii	221	229	221	Dec. 26	27 Arietis	232	214	236
30	ν Piscium	322	301	319	1839, May 2	W Sagittarii	57	57	57
1831, Jan. 20	ν Piscium	280	259	276	Sept. 26	66 Arietis	18	5	20
21	μ Ceti	306	288	304	26	20 Tauri	317	305	318
28	18 Leonis	287	305	292	Oct. 18	58 Aquarii	241	220	246
Apr. 15	α Tauri	242	233	243	1840, Jan. 11	δ Piscium	278	255	282
Dec. 17	γ Tauri	276	266	278	11	δ Piscium	55	32	59
1832, Feb. 15	ψ Leonis	231	249	236	13	μ Arietis	305	288	307
15	α Leonis	267	286	273	13	μ Arietis	45	28	47
Apr. 14	80 Virginis	255	276	257	14	q Tauri	302	290	303
1833, Dec. 26	μ Geminor.	214	215	219	14	18 Tauri	231	219	232
1834, Aug. 12	β Scorpii	311	322	306	14	q Tauri	57	45	58
12	β Scorpii	63	74	58	16	406 B. Tauri	241	239	240
Oct. 7	44 Ophiuchi	268	272	263	16	136 Tauri	347	345	345
8	λ Sagittarii	264	262	258	16	136 Tauri	11	9	9
1836, Apr. 25	η Leonis	218	237	218	Mar. 15	α Leonis	258	277	253
25	η Leonis	161	180	161	15	α Leonis	126	145	120
May 17	118 Tauri	327	323	331	Apr. 11	ν Leonis	324	343	319

BERLIN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1840, Apr. 16	85 Virginis	249	269	246	1884, Sept. 13	B. D.+17° 1502	150	156	149
May 8	ψ Leonis	273	291	269	13	B. D.+16° 1395	93	99	93
1841, Feb. 7	d Leonis	118	140	114	13	B. D.+16° 1398	64	70	64
May 23	ω Geminor.	294	299	289	13	B. D.+16° 1400	78	85	78
Aug. 10	17 Tauri	270	258	268	14	B. D.+14° 1822	32	44	33
10	16 Tauri	230	218	228	14	B. D.+14° 1825	62	73	63
10	20 Tauri	227	215	226	14	B. D.+14° 1828	73	85	74
10	16 Tauri	123	111	121	14	B. D.+14° 1829	74	85	75
10	17 Tauri	83	71	81	14	B. D.+14° 1838	59	71	60
10	η Tauri	313	301	311	14	B. D.+14° 1839	126	138	127
10	20 Tauri	124	112	123	15	B. D.+11° 1974	27	44	30
10	η Tauri	37	25	35	26	290 B. Ophiuchi	238	240	240
1843, Oct. 6	19 Piscium	241	218	241	28	B. D.−17° 5672	291	282	290
Nov. 27	c^2 Capricor.	289	271	291	28	B. D.−17° 5699	268	259	267
1845, Mar. 22	e Leonis	334	311	336	Oct. 30	11 Piscium	260	237	255
May 16	e Leonis	322	345	324	Nov. 22	B. D.−17° 5748	338	329	337
16	e Leonis	48	71	50	1885, Jan. 20	B. D.− 3° 5639	282	259	277
20	25 Libræ	298	313	303	20	B. D.− 3° 5642	265	242	261
June 16	10 Libræ	215	231	220	20	B. D.− 3° 5643	264	241	259
Oct. 20	71 Orionis	255	255	252	20	B. D.− 3° 5644	319	296	314
20	71 Orionis	106	106	103	21	98 B. Piscium	264	241	259
Nov. 6	ν Aquarii	204	188	204	22	e Piscium	286	264	281
6	ν Aquarii	142	126	142	23	B. D.+ 8° 307	297	278	293
9	22 Piscium	257	234	254	23	B. D.+ 8° 314	287	266	282
9	22 Piscium	100	77	96	23	B. D.+ 9° 264	218	197	213
1846, Aug. 14	68 Tauri	52	42	47	23	B. D.+ 9° 266	238	217	233
Sept. 14	68 Geminor.	78	86	77	24	B. D.+12° 411	269	252	265
Nov. 22	ρ Sagittarii	280	273	281	24	B. D.+12° 410	209	192	205
1876, Oct. 6	17 Tauri	245	232	248	25	B. D.+15° 546	272	260	269
6	17 Tauri	95	82	98	25	B. D.+15° 547	288	275	285
6	16 Tauri	197	184	199	25	B. D.+15° 557	314	301	310
6	16 Tauri	142	129	145	26	318 B. Tauri	334	328	332
6	23 Tauri	311	298	314	Feb. 1	d Leonis	86	108	90
6	23 Tauri	30	17	32	21	B. D.+14° 592	14	0	10
6	20 Tauri	204	191	206	21	B. D.+14° 595	291	277	288
6	η Tauri	298	285	301	21	B. D.+14° 597	288	275	285
6	24 Tauri	292	279	295	21	B. D.+14° 598	322	308	319
6	Anon. 24	259	246	262	21	B. D.+14° 600	272	258	268
6	20 Tauri	135	122	137	22	α Tauri	340	331	337
6	η Tauri	42	29	44	22	α Tauri	22	13	20
1879, Oct. 24	θ Aquarii	256	237	260	24	B. D.+17° 1339	239	242	239
1880, Sept. 11	θ Ophiuchi	190	195	195	24	B. D.+17° 1392	273	277	273
1881, Jan. 5	19 Piscium	340	317	340	24	B. D.+17° 1393	315	319	315
May 11	75 Virginis	325	347	328	Mar. 21	B. D.+15° 630	301	291	298
1884, Apr. 30	B. D.+15° 1619	280	289	280	21	75 Tauri	288	278	286
30	B. D.+15° 1620	206	215	206	21	B. D.+15° 633	348	338	346
30	B. D.+15° 1624	263	273	263	21	264 B. Tauri	338	328	335
30	B. D.+15° 1633	258	267	258	22	B. D.+17° 918	240	235	238
30	B. D.+15° 1635	297	307	297	22	B. D.+17° 919	295	291	294
30	B. D.+15° 1642	241	251	241	22	111 Tauri	295	291	294
May 2	ω Leonis	302	320	304	22	B. D.+17° 921	233	229	232
8	λ Virginis	225	245	230	22	B. D.+17° 929	318	314	317
29	B. D.+10° 1956	261	278	263	22	117 Tauri	326	322	324
June 28	B. D.+ 0° 2793	284	307	288	22	B. D.+17° 943	294	291	293
July 15	o Piscium	71	50	66	22	B. D.+17° 945	247	243	246
30	88 B. Libræ	307	323	311	22	B. D.+17° 950	256	252	255
Sept. 8	B. D.+ 9° 264	83	63	78	23	B. D.+17° 1225	289	290	289
12	B. D.+17° 1101	97	96	95	23	B. D.+17° 1226	229	230	229
12	B. D.+17° 1113	119	119	118	23	B. D.+17° 1230	308	309	308
12	B. D.+17° 1136	13	13	12	23	B. D.+17° 1231	308	310	308
12	B. D.+17° 1144	118	118	116	23	B. D.+17° 1238	297	299	297
12	B. D.+17° 1145	150	150	148	23	B. D.+17° 1241	321	323	321
12	B. D.+17° 1147	90	90	89	23	B. D.+17° 1247	257	259	257
12	B. D.+17° 1151	85	85	84	23	B. D.+17° 1252	274	276	274
12	B. D.+17° 1158	99	100	98	23	B. D.+17° 1256	290	292	290
12	B. D.+17° 1161	97	97	96	23	B. D.+17° 1261	228	230	228
12	124 H[1]. Orionis	133	132	131	23	B. D.+17° 1263	327	329	327
13	B. D.+16° 1380	110	116	110	23	B. D.+17° 1277	229	231	229
13	B. D.+17° 1495	144	150	144	23	B. D.+17° 1280	292	294	292
13	B. D.+16° 1385	99	105	99	23	B. D.+17° 1281	303	306	304

BERLIN—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1885, Mar. 23	B. D.+17° 1288	308	311	308
23	B. D.+17° 1291	327	330	328
23	B. D.+17° 1294	298	301	298
23	B. D.+17° 1307	248	250	248
Apr. 18	B. D.+17° 862	233	228	232
19	B. D.+17° 1136	305	305	305
19	B. D.+17° 1139	309	309	309
19	B. D.+17° 1146	259	259	259
19	B. D.+17° 1147	230	230	230
19	B. D.+17° 1151	233	233	233
19	B. D.+17° 1153	329	329	329
19	B. D.+17° 1154	297	298	297
19	B. D.+17° 1154	297	298	297
19	B. D.+17° 1155	293	293	292
19	B. D.+17° 1167	262	263	262
19	B. D.+17° 1172	296	296	296
19	B. D.+17° 1177	250	251	250
19	B. D.+17° 1179	282	282	281
19	B. D.+17° 1183	272	273	272
19	B. D.+17° 1191	316	316	315
20	B. D.+17° 1506	215	221	216
20	B. D.+16° 1400	293	299	294
20	B. D.+16° 1419	241	248	242
20	B. D.+16° 1421	245	252	246
20	B. D.+16° 1423	226	232	227
21	30 B. Cancri	238	250	240
22	209 B. Cancri	226	242	229
26	71 G. Virginis	235	258	240
May 19	B. D.+12° 1931	294	309	297
19	B. D.+12° 1942	219	235	223
19	α Cancri	322	338	325
July 6	B. D.+ 9° 296	112	93	108
6	B. D.+ 9° 301	97	78	93
7	B. D.+12° 453	77	62	74
9	α Tauri	307	298	305
21	B. D.−16° 4230	257	268	259
22	29 Ophiuchi	352	359	354
Aug 31	B. D.+13° 565	74	59	71
31	B. D.+13° 568	86	72	84
Sept. 1	θ^1 Tauri	98	89	97
1	θ^2 Tauri	78	68	76
1	B. D.+15° 633	144	135	143
1	B. D.+15° 635	130	121	129
1	269 B. Tauri	116	106	114
1	85 Tauri	33	24	32
1	B. D.+15° 646	62	52	60
1	B. D.+15° 648	42	33	41
1	B. D.+15° 649	40	30	38
1	275 B. Tauri	122	113	121
1	α Tauri	208	199	207
1	B. D.+15° 653	145	136	143
1	α Tauri	61	52	60
2	B. D.+17° 930	100	96	100
2	B. D.+16° 788	40	36	40
2	B. D.+17° 938	113	109	112
2	B. D.+17° 942	49	45	48
2	167 H[1]. Tauri	23	19	23
2	B. D.+17° 943	93	90	93
2	B. D.+17° 945	145	142	145
2	B. D.+17° 950	116	113	116
2	B. D.+17° 953	28	25	28
5	B. D.+14° 1932	136	150	139
5	B. D.+14° 1929	80	95	84
5	B. D.+14° 1930	79	93	82
16	B. D.−18° 4789	264	264	264
17	B. D.−18° 5134	306	301	304
17	B. D.−18° 5136	316	311	314
17	B. D.−18° 5155	298	292	296
17	B. D.−18° 5157	270	265	268
20	18 Aquarii	309	292	305
1885, Sept. 30	B. D.+17° 1195	71	72	72
30	292 B. Orionis	138	139	139
30	B. D.+17° 1223	153	154	154
30	B. D.+17° 1224	91	93	92
30	B. D.+17° 1226	109	110	110
Oct. 14	B. D.−18° 5012	246	243	245
16	B. D.−16° 5545	278	266	275
1894, Oct. 11	B. D.− 8° 6040	253	240	248
19	B. D.+28° 1095	94	96	94
19	B. D.+28° 1097	64	65	63
21	B. D.+24° 1918	116	128	113
23	B. D.+12° 2213	156	177	151
23	B. D.+12° 2215	47	68	42
Nov. 7	70 Aquarii	254	232	258
7	B. D.−11° 5933	278	256	283
7	B. D.−11° 5932	251	230	256
7	243 B. Aquarii	312	290	317
9	B. D.+ 0° 34	288	265	293
9	B. D.+ 1° 52	200	177	206
9	B. D.+ 2° 54	328	305	334
15	B. D.+27° 880	43	42	43
15	136 Tauri	26	25	26
15	B. D.+27° 914	36	35	36
15	B. D.+28° 958	129	128	129
15	B. D.+28° 966	102	101	102
16	B. D.+27° 1270	132	137	130
Dec. 1	C. D.−25° 14589	250	238	252
8	π Piscium	267	246	272
8	281 B. Piscium	297	275	301
8	B. D.+11° 210	266	245	271
11	χ Tauri	293	283	295
1895, Jan. 1	B. D.− 8° 5991	193	170	198
31	B. D.+ 6° 127	293	270	298
Feb. 6	B. D.+27° 1141	265	268	264
6	49 Aurigæ	221	224	220
7	B. D.+25° 1778	305	316	303
8	γ Cancri	287	302	284
Mar. 3	B. D.+25° 677	276	264	278
3	B. D.+25° 681	227	216	229
3	B. D.+25° 682	210	199	211
3	B. D.+25° 692	316	305	317
3	B. D.+25° 703	305	295	306
4	B. D.+27° 738	285	280	285
4	B. D.+27° 737	329	324	329
4	B. D.+27° 743	263	258	263
4	B. D.+27° 744	291	286	291
4	B. D.+27° 746	280	275	280
5	B. D.+27° 1078	298	299	297
5	B. D.+28° 1097	247	249	246
5	B. D.+27° 1090	300	301	299
5	B. D.+27° 1117	274	276	273
6	B. D.+26° 1495	313	320	311
6	134 B. Geminor.	281	288	279
6	B. D.+26° 1514	300	308	298
6	B. D.+26° 1516	288	295	286
6	B. D.+27° 1362	219	226	217
6	B. D.+26° 1525	249	257	248
6	B. D.+26° 1528	272	280	270
6	B. D.+26° 1531	354	1	352
6	B. D.+26° 1539	260	268	258
6	B. D.+26° 1554	307	315	305
6	B. D.+26° 1563	232	240	230
6	B. D.+26° 1561	321	329	319
6	B. D.+26° 1564	210	218	208
6	B. D.+26° 1580	258	267	256
8	B. D.+18° 2176	281	298	277
8	B. D.+18° 2181	239	257	235
8	B. D.+18° 2182	236	254	232
8	B. D.+17° 2092	312	330	308
9	B. D.+11° 2219	276	297	271

BERLIN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1895, Mar. 9	B. D.+11° 2222	262	283	257	1895, May 7	B. D.−16° 3802	268	288	264
11	B. D.− 1° 2632	142	165	136	28	B. D.+21° 1866	262	276	259
11	42 G. Virginis	147	170	142	28	B. D.+21° 1868	258	272	255
12	49 Virginis	78	100	73	29	B. D.+16° 1975	332	351	329
29	B. D.+20° 493	295	278	298	30	B. D.+11° 2217	262	283	257
29	B. D.+20° 496	241	225	244	30	B. D.+11° 2221	278	299	273
30	B. D.+24° 595	216	204	218	30	B. D.+11° 2223	283	304	278
30	B. D.+24° 603	260	248	262	30	45 Leonis	328	350	323
30	B. D.+24° 602	219	207	221	31	B. D.+ 5° 2467	257	280	252
31	B. D.+26° 764	308	301	309	June 9	284 B. Sagittarii	111	103	114
31	B. D.+27° 712	268	261	268	12	B. D.−15° 6103	170	151	175
31	B. D.+27° 716	280	273	280	12	B. D.−15° 6109	102	82	106
31	B. D.+27° 716	278	272	279	12	B. B.−15° 6111	110	90	114
Apr. 1	B. D.+28° 930	266	265	266	13	B. D.−10° 5973	87	65	92
1	B. D.+27° 895	341	339	340	13	B. D.−10° 5974	116	94	121
1	B. D.+28° 934	232	231	232	13	65 Aquarii	62	40	67
1	B. D.+28° 941	278	276	277	15	B. D.+ 0° 2	109	86	114
1	B. D.+28° 940	232	231	231	15	B. D.+ 0° 8	24	0	28
1	B. D.+27° 913	311	310	310	16	B. D.+ 6° 114	140	117	145
1	B. D.+27° 912	325	324	325	16	B. D.+ 6° 115	73	50	78
1	B. D.+27° 915	325	324	324	27	B. D.+ 6° 2387	314	336	309
1	B. D.+27° 933	344	343	343	July 2	C. D.−23° 12194	314	330	312
1	B. D.+28° 961	265	264	264	2	C. D.−23° 12202	306	322	304
1	B. D.+28° 966	261	260	260	2	C. D.−23° 12208	296	313	294
1	B. D.+28° 982	241	240	240	14	B. D.+ 9° 148	26	3	30
1	B. D.+27° 960	291	291	290	14	B. D.+ 9° 146	105	88	109
1	B. D.+27° 956	332	332	331	14	B. D.+10° 161	104	81	108
1	B. D.+28° 989	215	214	214	15	B. D.+15° 303	77	56	80
2	Anon.	253	258	251	15	B. D.+15° 304	62	42	65
2	B. D.+27° 1294	241	246	239	16	B. D.+19° 433	57	40	60
2	B. D.+27° 1293	230	236	228	16	47 Arietis	45	28	48
2	B. D.+27° 1293	226	232	225	17	27 Tauri	47	34	49
2	B. D.+27° 1296	263	269	262	17	28 Tauri	66	53	68
2	B. D.+27° 1292	341	346	339	17	B. D.+24° 589	132	120	134
2	B. D.+27° 1295	204	210	203	18	B. D.+26° 759	55	48	55
4	B. D.+19° 2153	282	299	278	Aug. 10	B. D.+ 8° 158	68	46	73
4	B. D.+19° 2170	264	281	260	10	180 B. Piscium	127	104	132
4	B. D.+19° 2171	256	272	252	13	B. D.+23° 462	112	98	114
4	B. D.+19° 2174	262	279	258	13	B. D.+23° 463	105	90	106
7	9 B. Virginis	324	347	318	13	B. D.+23° 465	97	82	98
7	B. D.− 0° 2507	290	314	285	13	B. D.+23° 468	45	31	47
10	B. D.−19° 3899	96	115	93	13	B. D.+23° 467	111	96	112
11	C. D.−23° 12251	100	116	98	13	B. D.+23° 469	103	89	105
11	C. D.−23° 12264	67	82	65	16	B. D.+27° 1133	101	103	99
12	C. D.−27° 10930	94	104	93	Sept. 2	B. D.−15° 6119	222	202	226
28	B. D.+27° 866	299	297	298	5	B. D.+ 1° 10	62	39	67
29	B. D.+27° 1213	278	282	276	5	B. D.+ 2° 16	99	76	104
29	B. D.+27° 1212	244	248	242	6	60 Piscium	30	7	34
29	B. D.+27° 1236	249	253	247	6	62 Piscium	121	98	125
30	B. D.+24° 1777	327	337	324	6	B. D.+ 6° 111	139	116	143
30	B. D.+24° 1783	297	308	294	9	B. D.+21° 413	32	16	34
May 1	γ Cancri	248	263	244	9	B. D.+21° 416	56	39	58
1	B. D.+21° 1914	279	294	275	9	B. D.+21° 427	58	42	60
1	B. D.+20° 2224	301	316	297	9	B. D.+22° 463	106	90	108
1	B. D.+20° 2228	290	305	286	9	B. D.+22° 466	104	89	106
1	B. D.+20° 2233	244	259	240	9	B. D.+22° 468	126	111	128
1	B. D.+20° 2232	299	315	296	9	B. D.+22° 469	84	69	86
2	B. D.+15° 2114	305	324	300	10	B. D.+24° 613	111	99	112
2	B. D.+15° 2117	227	242	222	10	B. D.+25° 667	109	98	110
2	B. D.+15° 2118	292	311	287	10	B. D.+24° 616	85	73	86
3	B. D.+10° 2176	267	288	262	10	B. D.+25° 671	105	93	106
5	98 B. Virginis	262	285	257	10	B. D.+24° 617	54	42	54
5	42 G. Virginis	260	284	256	10	B. D +25° 677	149	138	150
5	B. D.− 3° 3264	268	291	263	10	B. D.+25° 678	147	136	148
5	B. D.− 3° 3267	287	310	282	10	B. D.+25° 681	102	91	103
5	129 B. Virginis	275	298	270	10	B. D.+25° 682	104	93	105
5	B. D.− 4° 3275	256	280	251	10	B. D.+25° 685	119	108	120
5	B. D.− 4° 3281	288	311	283	11	B. D.+27° 733	74	68	74
6	B. D.−10° 3624	256	279	252	11	B. D.+27° 738	74	68	74
6	B. D.−10° 3627	292	314	288	29	B. D.−17° 6363	275	256	280

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Date.	Star.	m	m_1	m'
		°	°	°
1895, Sept. 29	δ Capricor.	266	247	271
29	B. D. −16° 5946	287	268	292
29	δ Capricor.	64	44	69
30	B. D. −11° 5842	275	254	280
30	58 Aquarii	275	254	280
Oct. 1	282 B. Aquarii	255	232	260
1	B. D. − 5° 5963	243	220	248
4	235 B. Piscium	123	101	127
4	B. D. +11° 175	116	93	119
7	η Tauri	27	14	28
7	24 Tauri	34	21	35
7	B. D. +23° 531	40	27	41
7	B. D. +23° 540	73	60	74
7	B. D. +23° 549	66	53	67
7	105 B. Tauri	67	54	68
7	B. D. +23° 560	63	50	64
7	B. D. +23° 561	58	45	59
7	B. D. +23° 567	37	24	38
7	B. D. +24° 578	61	48	62
7	B. D. +24° 595	101	88	102
7	B. D. +24° 598	102	90	103
9	406 B. Tauri	91	90	90
10	B. D. +27° 1230	68	72	66
11	B. D. +24° 1785	16	26	12
11	B. D. +24° 1783	109	119	106
11	B. D. +24° 1800	65	76	62
28	B. D. − 8° 5980	265	242	270
28	82 Aquarii	269	247	274
29	B. D. − 2° 6007	307	283	312
29	B. D. − 2° 6013	258	234	263
31	B. D. + 8° 158	280	257	284
31	180 B. Piscium	222	199	226
31	B. D. + 8° 177	335	312	339
31	210 B. Piscium	295	273	299
Nov. 1	B. D. +15° 290	270	249	273
10	B. D. +10° 2147	97	76	92
10	45 Leonis	119	97	114
25	B. D. − 3° 5638	230	206	234
28	B. D. +13° 250	226	204	230
28	B. D. +13° 267	262	240	265
29	B. D. +18° 319	242	224	245
30	B. D. +21° 416	271	254	272
30	B. D. +21° 427	267	251	269
30	B. D. +22° 466	215	200	216
30	B. D. +22° 469	238	222	239
Dec. 6	80 Cancri	149	166	144
29	B. D. +26° 750	293	285	292
29	B. D. +26° 752	290	282	289
29	B. D. +26° 764	282	274	281
29	B. D. +27° 716	253	246	252
1896, Jan. 8	B. D. −19° 3870	133	152	130
8	B. D. −19° 3869	60	79	58
8	B. D. −19° 3879	140	159	137
21	B. D. + 8° 153	332	309	336
21	B. D. + 9° 116	254	231	258
24	B. D. +22° 473	290	275	291
24	B. D. +22° 475	270	255	271
24	B. D. +22° 475	268	252	269
24	B. D. +22° 480	326	311	327
24	B. D. +22° 482	314	299	315
24	B. D. +23° 454	254	239	255
24	B. D. +23° 457	337	322	338
24	B. D. +23° 469	321	307	322
24	B. D. +23° 470	214	200	215
26	B. D. +27° 771	315	311	314
26	B. D. +27° 778	252	248	250
26	B. D. +27° 783	259	256	258
27	B. D. +27° 1066	294	295	292
27	B. D. +27° 1089	279	281	277
27	B. D. +27° 1090	205	207	203

Date.	Star.	m	m_1	m'
		°	°	°
1896, Jan. 28	B. D. +25° 1644	237	244	233
28	B. D. +25° 1659	258	266	255
28	B. D. +25° 1709	241	250	238
Feb. 19	B. D. +17° 339	255	236	258
19	B. D. +17° 346	285	266	287
20	B. D. +21° 403	195	178	196
20	B. D. +22° 438	256	239	257
20	B. D. +22° 441	241	225	243
20	B. D. +22° 446	276	260	277
20	B. D. +22° 453	238	222	239
20	B. D. +22° 455	270	255	272
20	B. D. +22° 457	238	222	239
21	B. D. +24° 598	314	301	314
21	B. D. +25° 656	226	214	226
21	B. D. +25° 674	262	250	262
21	B. D. +25° 677	280	268	280
21	B. D. +25° 678	250	239	250
22	B. D. +27° 702	290	282	289
22	B. D. +27° 712	299	292	298
22	Anon.	264	258	263
22	B. D. +27° 716	314	307	313
22	B. D. +27° 716	315	308	314
22	B. D. +27° 717	262	255	261
22	B. D. +27° 722	256	250	256
22	B. D. +27° 731	296	290	294
22	B. D. +27° 734	231	225	230
23	B. D. +27° 888	253	252	251
23	B. D. +28° 918	224	222	222
23	B. D. +28° 939	233	232	231
23	B. D. +27° 909	269	268	267
23	B. D. +27° 912	253	252	251
23	B. D. +27° 913	241	240	239
23	B. D. +27° 915	254	253	252
23	B. D. +27° 914	315	314	313
23	B. D. +28° 955	234	233	232
23	B. D. +27° 932	292	291	290
23	B. D. +27° 933	271	270	269
23	B. D. +27° 940	336	335	334
23	B. D. +27° 938	342	341	340
23	415 B. Tauri	317	316	315
23	B. D. +27° 950	281	280	279
24	B. D. +26° 1453	329	335	326
24	B. D. +25° 1594	290	296	286
24	B. D. +25° 1595	287	294	284
24	B. D. +25° 1596	306	312	302
24	B. D. +26° 1485	224	230	220
24	B. D. +25° 1608	284	291	281
24	49 Geminor.	237	243	233
26	78 Cancri	294	310	289
Mar. 21	B. D. +27° 799	259	256	258
21	B. D. +27° 798	213	210	212
21	B. D. +27° 803	274	270	272
21	107 B. Aurigæ	308	305	306
21	B. D. +27° 811	246	243	244
21	B. D. +27° 824	236	233	234
21	B. D. +27° 830	330	327	328
21	B. D. +27° 833	250	248	249
21	B. D. +27° 832	337	335	336
21	B. D. +27° 837	280	277	278
21	B. D. +27° 849	235	233	233
22	B. D. +27° 1144	262	265	260
22	B. D. +27° 1148	307	310	305
22	B. D. +27° 1164	220	223	217
22	B. D. +27° 1167	298	301	295
22	B. D. +27° 1181	284	287	281
22	B. D. +26° 1317	300	304	298
22	B. D. +26° 1333	344	348	341
22	B. D. +26° 1350	310	314	307
23	B. D. +25° 1706	279	284	275
23	B. D. +25° 1709	248	252	244

BERLIN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1896, Mar. 23	B. D.+25° 1725	240	245	236	1896, Sept. 14	C. D.−28° 14144	201	201	204
23	176 B. Geminor.	313	318	309	14	38 B. Sagittarii	241	241	244
23	B. D.+24° 1729	306	312	302	23	B. D.+11° 172	91	69	94
23	181 B. Geminor.	325	330	321	26	17 Tauri	31	18	31
23	B. D.+24° 1740	306	311	302	26	B. D.+23° 504	108	95	108
23	B. D.+24° 1746	275	280	271	26	16 Tauri	94	81	94
23	B. D.+24° 1750	326	335	322	26	q Tauri	111	97	110
23	B. D.+24° 1755	213	222	209	26	B. D.+23° 519	21	8	21
25	B. D.+15° 2075	285	303	280	26	B. D.+23° 512	73	60	73
25	B. D.+15° 2079	308	326	302	26	B. D.+24° 550	102	89	102
25	B. D.+15° 2080	307	325	302	26	20 Tauri	77	64	76
25	11 Leonis	303	322	298	26	B. D.+23° 523	36	23	36
25	B. D.+15° 2091	262	281	257	26	21 Tauri	118	105	118
Apr. 15	B. D.+23° 462	296	281	297	26	22 Tauri	108	95	108
15	B. D.+23° 463	298	284	299	26	B. D.+23° 540	16	2	15
15	B. D.+23° 469	269	254	269	26	B. D.+24° 562	89	76	88
20	B. D.+22° 1901	273	286	269	26	B. D.+24° 566	96	83	96
20	B. D.+21° 1807	289	302	285	26	B. D.+24° 567	111	98	111
26	83 Virginis	254	275	251	26	B. D.+24° 577	59	46	58
May 16	B. D.+25° 1570	258	264	254	26	B. D.+24° 587	143	131	143
16	B. D.+25° 1579	244	250	240	26	B. D.+24° 598	89	76	88
16	B. D.+25° 1590	264	271	261	28	B. D.+27° 818	100	97	97
16	B. D.+25° 1584	351	357	347	28	B. D.+27° 832	123	120	120
17	B. D.+22° 1836	288	299	283	28	B. D.+27° 846	72	69	69
17	B. D.+22° 1834	314	326	310	28	B. D.+27° 850	53	51	50
17	B. D.+22° 1852	272	283	267	28	B. D.+27° 856	58	55	55
21	B. D.+ 0° 2801	349	12	344	28	B. D.+27° 866	160	158	157
21	υ Leonis	272	296	268	29	B. D.+26° 1276	105	108	101
23	B. D.−12° 3785	248	270	245	29	B. D.+26° 1292	56	59	52
25	C. D.−23° 12133	288	304	288	29	B. D.+26° 1298	91	94	88
25	C. D.−23° 12202	222	238	222	29	B. D.+26° 1304	140	143	136
25	C. D.−23° 12208	208	224	208	29	B. D.+26° 1300	109	112	105
31	30 Capricor.	62	44	67	29	B. D.+26° 1302	64	68	61
June 2	B. D.− 8° 5961	31	9	36	29	B. D.+26° 1308	88	91	84
2	B. D.− 7° 5873	162	140	167	29	B. D.+26° 1309	53	56	49
2	B. D.− 8° 5964	50	28	55	29	B. D.+26° 1311	39	42	36
3	14 Piscium	129	106	134	29	B. D.+26° 1326	155	159	152
14	B. D.+19° 2094	266	280	261	29	B. D.+26° 1321	104	107	100
14	B. D.+19° 2095	274	289	269	29	B. D.+26° 1322	74	77	70
14	B. D.+19° 2097	200	215	195	29	B. D.+26° 1327	45	49	41
15	B. D.+14° 2123	282	300	277	29	B. D.+26° 1331	112	116	108
22	C. D.−26° 11106	314	326	314	29	B. D.+26° 1332	103	107	100
July 6	B. D.+24° 584	77	64	77	29	B. D.+26° 1333	104	108	101
6	B. D.+24° 589	99	86	99	29	B. D.+26° 1338	64	68	61
6	B. D.+24° 593	43	31	43	29	B. D.+26° 1342	47	51	43
27	B. D.− 6° 6110	111	89	116	Oct. 18	B. D.− 0° 4558	270	246	274
27	B. D.− 6° 6112	98	76	103	24	B. D.+25° 703	128	118	127
27	B. D.− 6° 6125	16	354	21	24	χ Tauri	50	39	48
Aug. 5	B. D.+26° 1205	103	105	100	25	B. D.+26° 827	65	61	62
5	B. D.+26° 1227	107	109	104	27	B. D.+25° 1597	126	132	122
5	B. D.+26° 1230	75	77	72	27	B. D.+24° 1549	31	37	27
5	B. D.+27° 1122	155	157	152	27	B. D.+24° 1562	53	59	49
21	B. D.−18° 5875	270	253	275	27	B. D.+24° 1567	41	47	37
23	B. D.− 8° 5932	44	22	49	27	B. D.+24° 1576	63	70	59
27	B. D.+14° 249	115	93	117	27	52 Geminor.	104	111	100
28	B. D.+17° 346	95	76	97	27	B. D.+25° 1625	116	123	111
28	B. D.+18° 300	112	93	114	27	B. D.+24° 1627	98	105	93
28	B. D.+18° 305	18	359	20	30	B. D.+11° 2153	78	98	73
28	B. D.+18° 312	51	32	52	30	B. D.+11° 2162	94	115	89
28	B. D.+19° 362	154	135	155	Nov. 10	B. D.−22° 5389	246	234	251
28	26 Arietis	111	92	112	12	B. D.−12° 6153	224	204	230
29	B. D.+21° 418	76	59	76	12	B. D.−12° 6152	223	203	228
29	B. D.+21° 423	56	40	56	13	B. D.− 7° 5837	241	219	246
29	B. D.+22° 455	114	98	114	13	B. D.− 7° 5847	237	214	241
29	161 B. Arietis	128	112	128	13	B. D.− 7° 5858	291	269	296
29	B. D.+22° 465	100	84	100	13	B. D.− 7° 5861	281	259	286
30	B. D.+25° 678	134	123	133	13	B. D.− 7° 5866	327	305	332
Sept. 3	B. D.+22° 1810	44	55	40	15	B. D.+ 3° 10	212	189	216
3	B. D.+22° 1834	41	52	37	15	B. D.+ 3° 15	263	240	267
14	C. D.−28° 14143	247	247	250	15	B. D.+ 4° 22	237	213	241

BERLIN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1896, Nov. 16	B. D.+ 8° 126	292	269	295	1902, Oct. 22	B. D.+16° 1421	103	110	103
16	B. D.+ 9° 110	246	223	249	22	B. D.+16° 1423	118	125	118
16	B. D.+ 9° 109	212	189	215	22	B. D.+16° 1426	140	147	140
16	B. D.+10° 123	222	200	225	22	λ Geminor.	234	241	234
17	104 Piscium	328	306	330	22	B. D.+16° 1436	63	70	62
26	B. D.+13° 2131	100	119	95	22	B. D.+16° 1441	115	122	114
26	47 B. Leonis	74	92	68	22	λ Geminor.	124	131	123
26	B. D.+13° 2139	64	82	58	22	B. D.+16° 1448	50	58	50
26	B. D.+13° 2147	42	61	37	23	B. D.+14° 1850	94	106	94
Dec. 16	B. D.+22° 438	246	230	246	23	B. D.+14° 1854	84	96	84
17	17 Tauri	283	270	282	24	κ Cancri	84	100	85
17	20 Tauri	242	229	242	24	B. D.+10° 1956	82	99	84
17	q Tauri	196	183	195	Nov. 8	B. D.−11° 5578	297	280	295
17	B. D.+23° 523	278	265	278	8	B. D.−11° 5583	336	318	334
17	B. D.+24° 562	228	214	227	8	B. D.−11° 5589	295	277	293
17	B. D.+23° 540	290	276	289	11	B. D.− 0° 4566	255	231	250
17	B. D.+24° 566	217	204	216	11	21 Piscium	192	168	187
17	B. D.+23° 553	296	283	294	14	B. D.+12° 354	261	242	256
17	B. D.+23° 560	299	286	298	14	B. D.+12° 370	266	248	261
17	B. D.+23° 561	305	292	304	17	B. D.+18° 990	129	128	127
17	B. D.+23° 567	339	326	338	17	B. D.+18° 1001	72	71	70
17	B. D.+24° 578	298	286	298	17	B. D.+18° 1012	146	145	144
17	B. D.+24° 602	265	253	264	18	B. D.+17° 1392	55	59	54
18	B. D.+26° 775	279	273	277	18	41 H¹. Geminor.	34	40	33
1897, Jan. 7	252 B. Aquarii	257	235	262	19	B. D.+15° 1672	87	97	87
10	B. D.+10° 128	273	250	275	19	B. D.+15° 1676	26	36	26
10	B. D.+11° 146	184	161	186	20	B. D.+12° 1927	103	118	104
10	B. D.+11° 152	249	226	252	20	60 Cancri	100	115	101
1902, May 11	41 H¹. Geminor.	353	359	351	22	34 Sextantis	85	107	89
11	B. D.+16° 1373	294	300	293	22	B. D.+ 3° 2406	30	52	34
11	B. D.+17° 1488	228	234	227	22	B. D.+ 4° 2378	74	96	78
11	B. D.+16° 1380	288	294	287	22	B. D.+ 3° 2411	71	93	75
11	B. D.+16° 1385	284	290	283	Dec. 11	34 B. Arietis	263	242	257
14	B. D.+ 7° 2203	215	235	217	11	B. D.+10° 292	340	320	335
15	36 Sextantis	255	277	258	11	B. D.+11° 295	270	250	265
17	B. D.− 5° 3487	257	281	262	12	B. D.+13° 494	279	262	274
18	B. D.− 9° 3640	295	318	300	13	180 B. Tauri	202	190	198
19	B. D.−12° 3933	264	285	269	13	B. D.+16° 561	232	220	228
25	B. D.−18° 5155	129	124	131	13	193 B. Tauri	270	259	266
June 15	86 Virginis	266	287	271	13	δ Tauri	269	258	265
18	B. D.−19° 4332	279	290	284	13	64 Tauri	291	280	287
18	ν Scorpii	281	292	286	1903, Jan. 6	171 B. Piscium	259	236	254
23	B. D.−15° 5663	62	49	60	9	B. D.+15° 531	263	250	259
25	B. D.− 8° 5791	147	127	145	12	B. D.+17° 1409	228	232	227
27	B. D.− 0° 4547	108	84	104	15	B. D.+ 7° 2227	84	104	87
28	116 B. Piscium	168	144	163	15	B. D.+ 7° 2232	117	137	120
28	B. D.+ 3° 56	99	75	94	18	B. D.− 6° 3656	88	111	93
28	B. D.+ 4° 66	113	89	108	19	h Virginis	40	62	45
28	B. D.+ 4° 73	93	70	89	19	B. D.− 9° 3736	132	154	137
July 15	B. D.−18° 4196	263	276	268	20	6 G. Libræ	123	142	128
19	ρ Sagittarii	225	217	226	Feb. 2	B. D.+ 3° 86	299	276	294
21	8 Aquarii	41	25	40	6	B. D.+16° 577	299	288	295
21	B. D.−13° 5830	127	111	126	6	B. D.+16° 582	288	278	284
22	B. D.− 9° 5854	125	105	122	6	B. D.+16° 591	304	294	300
28	B. D.+14° 502	163	146	158	6	64 Tauri	213	203	209
Oct. 10	B. D.−16° 5478	232	221	232	6	B. D.+17° 722	219	209	215
11	87 B. Capricor.	295	280	294	6	B. D.+16° 600	292	282	288
19	B. D.+16° 561	136	125	136	6	B. D.+16° 602	322	313	319
19	B. D.+16° 568	96	85	92	6	B. D.+16° 606	265	256	262
19	193 B. Tauri	96	85	92	7	B. D.+18° 825	252	247	249
21	B. D.+17° 1135	78	78	76	7	115 Tauri	297	293	294
21	B. D.+17° 1144	71	71	68	9	B. D.+16° 1506	259	268	259
21	B. D.+18° 1112	137	137	135	9	68 Geminor.	284	293	284
21	B. D.+17° 1158	52	52	50	9	67 Geminor.	333	342	333
21	B. D.+17° 1161	49	49	46	9	B. D.+15° 1605	308	317	308
21	124 H¹. Orionis	82	83	80	9	B. D.+16° 1518	273	282	273
21	B. D.+18° 1147	143	144	141	12	155 B. Leonis	79	100	82
21	B. D.+18° 1178	128	130	126	15	487 B. Virginis	104	126	109
21	B. D.+18° 1179	126	128	124	16	B. D.−11° 3659	38	58	42
22	B. D.+16° 1419	109	116	109	16	B. D.−11° 3668	110	130	115

BERLIN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1903, Feb. 16	B. D. −11° 3684	91	111	96	1903, Mar. 7	B. D.+17° 1154	341	342	338
Mar. 2	B. D.+ 6° 195	273	251	268	8	B. D.+17° 1469	263	268	263
4	B. D.+13° 499	240	224	236	8	B. D.+17° 1477	252	258	252
6	B. D.+17° 841	256	250	253	8	41 H^1. Geminor.	312	317	311
7	B. D.+17° 1082	296	295	293	8	B. D.+16° 1373	278	283	277
7	B. D.+17° 1089	277	276	274	8	B. D.+16° 1380	273	279	273
7	B. D.+18° 1061	243	243	241	8	B. D.+17° 1488	187	193	187
7	B. D.+18° 1060	228	228	226	8	B. D.+16° 1385	272	278	272
7	B. D.+18° 1067	245	245	243	8	B. D.+16° 1395	265	271	264
7	B. D.+17° 1101	323	323	321	8	B. D.+16° 1398	289	295	288
7	B. D.+17° 1113	285	285	282	8	B. D.+16° 1400	271	277	270
7	B. D.+18° 1084	202	202	199	8	51 Geminor.	310	317	310
7	B. D.+17° 1135	248	248	245	8	B. D.+16° 1421	199	206	198
7	B. D.+17° 1144	247	247	244	12	B. D.+ 2° 2386	274	297	279
7	B. D.+17° 1147	268	268	265	12	p^4 Leonis	252	275	257
7	B. D.+17° 1151	269	270	266	17	34 Libræ	90	105	94
7	B. D.+17° 1158	242	243	239	17	ζ Libræ	63	77	67

CAMBRIDGE, ENGLAND.

1791, June 12	λ Virginis	223	242	228	1826, Jan. 13	19 Piscium	239	216	237
1793, Apr. 19	ξ Leonis	327	344	331	1827, Dec. 8	ω Leonis	102	119	103
1794, Mar. 5	μ Ceti	275	257	273	1829, Jan. 18	λ Geminor.	305	311	306
7	α Tauri	208	197	209	Oct. 15	α Tauri	216	207	214
Nov. 8	α Tauri	279	270	281	15	α Tauri	138	129	136
8	α Tauri	112	103	114	1830, Mar. 28	θ^1 Tauri	287	277	286
Dec. 18	γ Libræ	102	116	101	28	θ^2 Tauri	309	299	308
1795, Oct. 6	δ Cancri	54	67	59	28	85 Tauri	335	325	334
1797, Mar. 17	ν Scorpii	137	148	132	29	117 Tauri	309	305	309
Dec. 25	33 Piscium	242	219	243	Apr. 5	τ Leonis	268	291	273
1798, Oct. 5	η Leonis	234	253	234	May 1	48 Leonis	256	277	261
1799, Apr. 10	125 Tauri	271	267	275	1831, Feb. 20	111 Tauri	310	306	311
1800, Sept. 30	ψ Aquarii	305	283	310	Oct. 23	α Tauri	284	275	286
Nov. 26	ζ Piscium	211	189	216	23	α Tauri	63	54	65
1801, Mar. 30	α Virginis	296	318	291	1847, Jan. 25	180 B. Tauri	230	218	226
30	α Virginis	88	110	83	Feb. 24	u Geminor.	234	238	233
May 21	χ Leonis	311	333	306	Apr. 22	A^2 Cancri	241	256	243
24	α Virginis	299	321	294	May 23	υ Leonis	269	292	274
24	α Virginis	89	111	84	28	ζ Libræ	246	261	251
Oct. 23	η Tauri	235	223	238	June 1	ρ Sagittarii	259	252	259
23	η Tauri	104	92	107	1	ρ Sagittarii	101	93	101
23	27 Tauri	62	50	65	Nov. 18	44 Piscium	329	306	324
23	28 Tauri	80	68	82	1848, Jan. 16	α Tauri	308	298	306
1811, Mar. 1	α Tauri	266	257	264	16	α Tauri	47	38	45
1	α Tauri	101	92	99	Mar. 21	m Virginis	224	245	228
Oct. 27	λ Aquarii	298	276	293	June 13	30 Libræ	240	255	243
1813, Mar. 6	μ Ceti	248	230	247	July 11	θ Libræ	335	348	338
8	α Tauri	260	251	255	15	246 B. Sagittarii	318	310	316
July 11	μ Sagittarii	305	305	302	Aug. 21	γ Tauri	249	239	248
Nov. 29	δ Capricor.	313	295	308	21	γ Tauri	106	96	105
1814, Jan. 1	μ Ceti	223	205	224	Nov. 9	ξ^1 Ceti	325	305	321
28	ξ^2 Ceti	285	266	285	9	ξ^1 Ceti	33	14	30
Feb. 1	ν Geminor.	294	296	298	Dec. 4	20 Piscium	222	236	217
Oct. 1	μ Ceti	285	267	287	1849, Jan. 3	ξ^1 Ceti	216	202	218
1820, Feb. 1	χ Leonis	300	322	296	Mar. 2	130 Tauri	246	244	248
1	χ Leonis	78	100	73	3	26 Geminor.	292	295	294
1821, Feb. 6	δ Piscium	224	201	228	8	82 Leonis	339	1	344
May 6	κ Geminor.	302	310	298	Sept. 5	ν Piscium	216	194	213
Oct. 13	17 Tauri	297	285	298	5	ν Piscium	141	120	138
13	q Tauri	231	219	232	8	71 Tauri	112	102	112
13	20 Tauri	262	250	263	8	θ^2 Tauri	203	193	204
13	17 Tauri	47	35	47	8	81 Tauri	275	266	276
13	16 Tauri	84	72	84	8	80 Tauri	69	60	70
15	136 Tauri	227	225	225	8	81 Tauri	74	65	75
15	136 Tauri	124	122	122	1850, Jan. 23	γ Tauri	214	227	215
1822, Sept. 6	q Tauri	279	267	278	23	γ Tauri	86	98	87
1823, Jan. 24	ε Geminor.	280	283	275	23	θ^1 Tauri	262	274	263
May 18	p^5 Leonis	308	331	305	Apr. 15	α Tauri	91	82	92
1824, Jan. 7	19 Piscium	217	194	219	May 28	36 Sagittarii	273	268	269
1825, Apr. 1	c Leonis	295	318	295	28	36 Sagittarii	103	98	98

CAMBRIDGE, ENGLAND—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1850, July 21	21 Sagittarii	220	219	216	1854, Sept. 30	ω Sagittarii	262	252	259
21	21 Sagittarii	147	145	143	30	A Sagittarii	270	259	267
24	21 Capricor.	292	276	287	1855, Mar. 23	k Tauri	230	223	234
Aug. 2	α Tauri	280	271	282	Apr. 23	λ Cancri	80	93	81
14	γ Libræ	260	274	259	June 27	22 Scorpii	82	92	77
14	γ Libræ	102	116	101	Aug. 30	o Piscium	261	239	266
Sept. 12	29 Ophiuchi	210	216	207	Sept. 20	234 B. Sagittarii	239	232	238
Nov. 21	64 Orionis	106	105	110	21	40 B. Capricor.	241	228	241
21	68 Orionis	275	275	279	Oct. 24	o Piscium	300	279	305
1851, Jan. 15	64 Orionis	238	238	243	Nov. 15	86 B. Capricor.	254	238	254
Mar. 13	θ Cancri	258	272	263	1856, Mar. 11	33 Tauri	239	227	243
Apr. 6	m Tauri	274	268	277	13	136 Tauri	269	268	272
6	m Tauri	88	82	91	26	α Scorpii	289	299	285
7	χ^2 Orionis	265	265	270	June 16	α Scorpii	281	291	277
July 21	ξ^2 Ceti	150	131	151	July 25	63 Arietis	182	167	186
Sept. 14	μ Ceti	113	95	114	Sept. 20	136 Tauri	329	327	330
Oct. 2	222 B. Sagittarii	106	98	100	20	136 Tauri	13	12	15
11	ξ^2 Ceti	307	288	308	Nov. 11	40 Arietis	225	207	230
11	ξ^2 Ceti	45	26	46	1857, Mar. 4	49 Aurigæ	96	99	96
Dec. 10	63 Geminor.	247	254	252	Apr. 2	λ Cancri	251	263	248
10	63 Geminor.	70	78	75	2	λ Cancri	131	143	128
1852, Feb. 3	63 Geminor.	266	274	272	May 6	α Virginis	75	98	70
May 2	94 Virginis	304	324	302	Sept. 30	50 Aquarii	293	272	297
July 4	29 Aquarii	118	98	114	Oct. 6	27 Tauri	218	205	221
Aug. 26	36 B. Capricor.	319	306	315	6	27 Tauri	126	112	128
1853, Jan. 14	30 Piscium	141	118	141	6	28 Tauri	186	173	188
14	33 Piscium	255	232	255	6	28 Tauri	157	144	160
14	33 Piscium	89	66	89	Nov. 27	ε Piscium	311	288	316
Feb. 17	n Tauri	230	225	235	1858, Feb. 19	ε Arietis	227	210	230
Mar. 26	95 Virginis	276	297	273	20	q Tauri	257	243	259
26	95 Virginis	105	125	102	20	q Tauri	87	74	89
Apr. 20	ν Virginis	93	116	93	20	20 Tauri	57	44	59
May 20	95 Virginis	263	283	259	May 18	83 Cancri	199	217	195
20	95 Virginis	120	140	117	19	α Leonis	344	4	339
Sept. 20	38 Arietis	271	253	275	19	α Leonis	42	62	37
Dec. 9	33 Ceti	182	160	185	Aug. 30	16 Tauri	303	289	304
1854, Feb. 7	121 Tauri	279	276	284	30	q Tauri	272	258	273
9	52 Geminor.	294	301	298	30	q Tauri	70	56	71
9	52 Geminor.	61	68	65	30	20 Tauri	308	294	309
Mar. 12	42 Leonis	307	328	307	Sept. 18	17 Capricor.	226	211	231
12	167 B. Leonis	257	278	257	Nov. 22	136 Tauri	259	257	257
Apr. 4	ε Geminor.	345	349	350	22	136 Tauri	93	91	91
May 9	48 Virginis	297	319	293	1859, Feb. 16	ψ Leonis	248	267	243
9	48 Virginis	82	105	78	1860, Feb. 28	16 Tauri	333	320	332
Sept. 4	35 Capricor.	278	260	277	28	20 Tauri	316	303	315
4	35 Capricor.	69	51	68	28	22 Tauri	279	266	278

CAMBRIDGE, MASS.

1840, July 10	τ Scorpii	320	328	321	1847, Jan. 5	34 Sextantis	69	91	72
Oct. 6	45 Capricor.	236	218	241	25	δ Tauri	326	316	323
Nov. 2	ι Capricor.	241	225	246	25	68 Tauri	246	236	242
1842, Apr. 12	ε Arietis	305	289	303	Aug. 19	7 Ophiuchi	313	323	316
1843, Jan. 24	σ Scorpii	57	67	62	Sept. 16	29 Ophiuchi	286	293	288
Sept. 30	39 Sagittarii	219	214	224	1848, Jan. 12	80 Piscium	267	245	262
Nov. 3	45 Piscium	263	240	262	Feb. 12	α Tauri	331	322	329
1844, Feb. 22	104 Piscium	291	270	287	12	α Tauri	20	11	18
1845, July 16	58 Ophiuchi	248	250	253	Mar. 11	111 Tauri	320	316	319
17	29 Sagittarii	285	281	289	Apr. 12	o Leonis	274	292	278
Sept. 22	57 Orionis	117	115	113	May 4	α Tauri	317	308	315
22	64 Orionis	86	85	82	Aug. 7	η Libræ	232	245	234
Nov. 10	δ Piscium	295	272	290	Sept. 15	65 Ceti	90	70	86
Dec. 6	22 Piscium	292	269	289	Oct. 28	η Libræ	235	248	236
1846, Feb. 6	71 Orionis	287	288	284	1849, Jan. 5	γ Tauri	280	270	280
20	16 Sagittarii	66	65	70	5	γ Tauri	68	58	68
Mar. 31	97 Tauri	302	295	298	5	75 Tauri	246	236	245
May 3	ω Leonis	218	235	219	6	111 Tauri	295	291	296
June 29	69 Leonis	296	319	299	Feb. 9	5 Virginis	286	309	291
1847, Jan. 3	65 Cancri	109	124	109	Mar. 11	95 Virginis	122	142	125

CAMBRIDGE, MASS.—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1849, May 2	5 Virginis	275	298	280	1850, May 19	σ Leonis	291	314	296
July 16	α Tauri	249	240	250	19	σ Leonis	78	101	82
16	α Tauri	106	97	106	June 13	82 Cancri	286	302	290
Sept. 27	29 Capricor.	321	305	317	14	α Leonis	272	292	277
Nov. 22	40 Aquarii	290	270	286	14	α Leonis	95	115	100
29	θ^2 Tauri	298	288	299	Aug. 8	α Leonis	337	357	342
29	α Tauri	266	257	267	8	α Leonis	25	45	30
1850, Jan. 23	θ^2 Tauri	271	261	272	27	73 Ceti	252	233	252
23	α Tauri	247	238	248	27	73 Ceti	96	77	96
23	α Tauri	100	91	101	30	α Tauri	303	294	305
Feb. 26	σ Leonis	259	282	264	Oct. 13	7 Capricor.	240	228	236
Mar. 24	27 Leonis	202	221	207	14	23 Capricor.	232	216	227
Apr. 15	α Tauri	304	295	306	21	87 Ceti	220	202	220
15	α Tauri	41	32	43	21	87 Ceti	129	111	128
18	g Geminor.	225	235	230					

CAPE OF GOOD HOPE.

		*					*		
1834, July 14	8 G. Libræ	250	270	248	1844, June 25	40 H. Virginis	206	217	201
Aug. 30	κ Geminor.	94	89	94	25	40 H. Virginis	156	168	152
1835, Jan. 18	ξ Virginis	229	249	225	1847, Apr. 25	d Leonis	251	268	250
18	ξ Virginis	154	173	150	June 17	o Leonis	277	290	274
June 12	h Sagittarii	250	244	248	Oct. 18	ν Aquarii	289	279	293
14	ε Capricor.	302	289	305	1848, Apr. 15	B. A. C. 4019	325	343	325
Aug. 6	51 Sagittarii	229	220	225	May 17	γ Libræ	283	299	287
6	h Sagittarii	265	261	265	June 8	τ Leonis	316	333	315
6	h Sagittarii	108	103	107	1849, Feb. 13	ξ Libræ	100	119	104
8	κ Capricor.	300	286	303	Apr. 6	γ Virg. (N)	287	306	288
Oct. 29	κ Capricor.	242	222	240	6	γ Virg. (S)	287	306	288
1836, Feb. 8	4 G. Libræ	119	142	117	July 13	ξ^1 Ceti	13	359	18
Aug. 22	φ Sagittarii	267	267	267	Sept. 25	ρ Sagittarii	224	217	220
22	φ Sagittarii	92	92	92	25	ρ Sagittarii	126	119	123
Sept. 16	ρ Ophiuchi	241	252	238	Oct. 3	ξ^1 Ceti	44	29	47
21	ε Capricor.	262	242	261	Nov. 23	λ Aquarii	245	226	243
Oct. 21	27 Piscium	230	200	227	23	λ Aquarii	98	80	97
21	29 Piscium	255	226	253	26	μ Piscium	227	204	223
1837, June 16	δ Scorpii	226	239	222	Dec. 1	ν Geminor.	137	132	133
Aug. 11	O. A. 16481	270	278	270	1850, Jan. 17	φ Aquarii	238	217	235
1838, Aug. 12	q Tauri	42	30	46	23	64 Tauri	214	198	210
Oct. 5	ε Arietis	49	31	52	25	ν Geminor.	250	246	248
Nov. 29	ε Arietis	309	292	312	25	ν Geminor.	109	106	107
1839, May 6	δ Capricor.	109	83	107	Feb. 21	64 Orionis	324	324	328
24	α Virginis	352	24	357	21	χ^2 Orionis	223	216	219
24	α Virginis	19	50	24	Apr. 17	ν Geminor.	304	306	307
June 24	α Scorpii	244	253	242	July 30	ν Piscium	68	51	70
Aug. 17	A^1 Scorpii	277	292	278	Aug. 31	χ^2 Orionis	322	322	326
17	A^2 Scorpii	255	268	253	Sept. 1	ζ Geminor.	90	91	90
1840, Feb. 15	γ Cancri	338	2	343	30	δ Cancri	74	84	75
Mar. 23	α Scorpii	118	126	116	Nov. 17	ξ^1 Ceti	194	169	189
May 9	ρ Leonis	287	313	287	17	ξ^1 Ceti	152	128	148
18	3 Sagittarii	107	106	106	1851, Mar. 9	68 Tauri	272	259	272
19	φ Sagittarii	265	259	265	26	υ Capricor.	223	210	219
19	φ Sagittarii	94	87	94	Apr. 18	24 Scorpii	162	169	157
20	h Sagittarii	270	258	270	May 17	μ Sagittarii	310	318	314
20	h Sagittarii	100	87	99	17	μ Sagittarii	33	40	37
22	ι Capric	284	264	285	18	36 Sagittarii	222	218	218
22	ι Capric	54	34	57	18	ξ Sagittarii	331	336	336
June 12	A^1 Scorpii	296	311	298	18	ξ Sagittarii	38	42	42
1841, June 30	α Scorpii	288	297	290	June 7	c Virginis	233	251	230
1843, Sept. 11	η Piscium	187	173	192	17	ι Capricor.	122	107	120
1844, Jan. 8	π Leonis	272	293	272	July 12	π Sagittarii	281	282	282
8	π Leonis	98	119	97	Aug. 8	ξ Sagittarii	249	248	247
31	2 Geminor.	241	248	243	8	ξ Sagittarii	117	115	115

* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m′
		°	°	°
1851, Oct. 28	30 G. Sagittarii	311	320	315
Dec. 7	ε Tauri	226	209	222
7	ε Tauri	119	103	117
31	ν Piscium	295	271	293
1852, Feb. 15	ο Sagittarii	246	244	244
15	ο Sagittarii	138	133	134
Mar. 9	ξ Libræ	242	260	240
9	ξ Libræ	145	160	141
Sept. 23	η Capricor.	316	308	320
1853, Apr. 20	ξ Virginis	207	225	202
Sept. 6	88 Virginis	253	276	251
8	174 B. Libræ	295	315	297
11	126 B. Sagittarii	306	310	309
Dec. 8	54 B. Ceti	330	310	335
1854, Mar. 7	139 Tauri	338	338	343
7	139 Tauri	21	20	26
20	b Ophiuchi	95	104	95
22	h Sagittarii	263	258	262
22	h Sagittarii	117	110	115
Apr. 13	κ Virginis	308	336	311
13	κ Virginis	74	99	75
15	ω^1 Scorpii	42	63	46
May 11	6 B. Libræ	244	265	242
11	μ Libræ	239	259	236
11	μ Libræ	132	151	129
22	μ Piscium	253	225	251
June 7	κ Virginis	258	282	257
7	κ Virginis	60	86	62
14	κ Capricor.	245	226	243
14	κ Capricor.	129	108	126
28	ξ Cancri	242	255	240
28	79 Cancri	222	233	218
July 5	μ Libræ	212	229	207
13	ψ^3 Aquarii	44	23	47
Sept. 2	201 B. Sagittarii	242	237	240
2	201 B. Sagittarii	104	99	103
Oct. 29	κ Capricor.	263	243	262
Nov. 27	ψ^2 Aquarii	274	249	274
27	ψ^2 Aquarii	64	40	66
1855, Jan. 3	υ Geminor.	110	114	108
Apr. 4	8 Libræ	118	139	116
4	α Libræ	273	296	273
4	α Libræ	115	136	113
8	φ Sagittarii	248	246	246
8	φ Sagittarii	134	131	131
May 8	ε Capricor.	231	209	228
1856, Apr. 25	τ Sagittarii	267	262	267
25	τ Sagittarii	88	87	88
Sept. 8	38 B. Sagittarii	297	300	299
Nov. 12	η Tauri	275	259	276
1857, Jan. 15	η Virginis	236	261	233
15	η Virginis	157	181	153
Feb. 6	φ Geminor.	242	251	240
Mar. 16	σ Scorpii	252	263	250
16	σ Scorpii	140	149	136
16	α Scorpii	266	278	266
18	38 B. Sagittarii	185	181	180
18	38 B. Sagittarii	16	22	21
19	τ Sagittarii	36	34	40
31	κ Aurigæ	240	238	237
Apr. 29	φ Geminor.	262	273	261
May 31	β Virginis	327	359	331
July 27	α Virginis	306	336	309
Nov. 23	γ Capricor.	281	259	282
23	γ Capricor.	47	28	50
1858, Mar. 6	α Scorpii	259	269	258
6	α Scorpii	124	132	121
Oct. 12	X Sagittarii	252	250	250
14	h Sagittarii	270	258	270
1859, Jan. 21	c Leonis	105	131	104
1859, Feb. 8	η Piscium	230	201	226
11	φ Tauri	341	337	346
Aug. 18	η Piscium	183	154	178
18	η Piscium	161	132	156
Oct. 28	α Scorpii	280	289	281
28	α Scorpii	63	69	62
Nov. 8	η Piscium	218	190	214
Dec. 21	σ Scorpii	250	257	248
21	α Scorpii	301	311	304
1860, Feb. 13	A Scorpii	296	310	298
Mar. 7	υ Leonis	315	346	319
7	υ Leonis	65	94	67
12	α Scorpii	306	316	309
12	α Scorpii	66	75	68
28	354 B. Tauri	227	222	223
Apr. 27	μ Cancri	231	245	228
May 1	υ Leonis	297	326	299
8	λ Sagittarii	131	122	128
25	δ Cancri	301	324	304
June 3	A^2 Ophiuchi	285	288	286
3	A^2 Ophiuchi	53	57	56
3	A^1 Ophiuchi	53	57	56
Aug. 24	A^1 Ophiuchi	298	302	301
30	θ Aquarii	99	72	98
Oct. 17	22 Scorpii	228	230	224
1862, Dec. 7	μ Geminor.	88	95	88
13	p^5 Leonis	286	311	288
1863, Jan. 27	ζ Arietis	278	268	279
Mar. 12	58 Ophiuchi	85	83	85
Apr. 7	ω Ophiuchi	239	240	236
8	58 Ophiuchi	264	261	264
May 4	ω^2 Scorpii	214	216	210
June 28	ω^2 Scorpii	221	224	217
28	ω^2 Scorpii	161	162	156
30	21 Sagittarii	111	102	109
Nov. 17	ξ Aquarii	284	266	285
1864, Feb. 29	ψ Ophiuchi	277	283	285
29	ψ Ophiuchi	98	102	97
Mar. 24	α Virginis	303	323	306
24	α Virginis	75	94	76
27	ν Scorpii	226	228	222
Apr. 27	e Sagittarii	127	113	124
July 18	e Sagittarii	243	229	240
18	e Sagittarii	103	91	102
Dec. 6	κ Piscium	275	254	275
6	κ Piscium	67	49	69
1865, Mar. 15	λ Virginis	319	337	323
15	λ Virginis	42	60	46
1866, May 11	ζ Piscium	265	248	265
20	ο Leonis	352	348	357
July 8	68 Tauri	86	79	86
26	e Sagittarii	284	277	285
26	e Sagittarii	101	92	100
Aug. 29	ο Piscium	98	80	97
Sept. 15	φ Ophiuchi	213	216	209
15	φ Ophiuchi	151	154	147
1867, Jan. 29	φ Ophiuchi	14	27	19
Apr. 16	η Virginis	241	257	238
16	η Virginis	137	152	134
Dec. 28	τ Capricor.	309	302	312
1868, Apr. 4	χ Leonis	292	312	294
Aug. 9	ξ^1 Ceti	287	271	289
1869, Mar. 23	δ Cancri	229	234	225
23	δ Cancri	158	163	153
Aug. 19	ρ Capricor.	185	172	180
19	ρ Capricor.	168	155	163
29	δ Tauri	268	255	268
29	δ Tauri	73	62	74
1870, Feb. 22	24 Scorpii	225	233	221
22	24 Scorpii	161	168	156

*See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m′	Date.	Star.	m*	m_1	m′
		°	°	°			°	°	°
1870, Mar. 10	ζ Tauri	290	285	292	1882, Nov. 18	138 B. Aquarii	226	203	222
23	15 Sagittarii	139	139	135	18	B. D.−5° 5738	191	166	186
Sept. 7	δ Capricor.	280	266	281	Dec. 5	α Virginis	324	345	328
7	δ Capricor.	54	42	57	5	α Virginis	43	65	47
28	γ Libræ	221	234	217	1883, Feb. 14	164 B. Tauri	299	231	302
28	γ Libræ	141	154	137	Apr. 28	54 Sagittarii	21	15	26
Dec. 27	ψ¹ Aquarii	253	231	251	May 13	h Leonis	245	260	243
27	ψ² Aquarii	334	318	339	July 19	e Sagittarii	261	244	260
1871, Feb. 1	1 Geminor.	264	257	263	Sept. 7	32 Libræ	229	235	225
1	1 Geminor.	90	85	90	Nov. 13	29 Arietis	251	235	249
May 5	θ Libræ	118	133	116	1884, Jan. 2	44 Aquarii	274	256	274
June 29	θ Libræ	253	268	251	7	o Arietis	315	306	319
1875, Aug. 10	σ Scorpii	238	248	235	Mar. 8	209 B. Cancri	306	324	309
1876, Mar. 5	ι Geminor.	297	308	299	9	89 B. Leonis	291	310	293
1879, Oct. 31	20 Tauri	66	58	68	9	π Leonis	290	309	292
1880, Feb. 5	θ Ophiuchi	269	269	269	15	μ Libræ	61	76	63
5	θ Ophiuchi	111	109	109	24	κ Aquarii	115	95	113
18	χ Tauri	263	256	262	May 1	29 Cancri	350	8	355
Mar. 3	26 Ophiuchi	36	42	40	30	89 B. Leonis	324	345	328
4	7 Sagittarii	102	97	101	June 5	μ Libræ	315	330	317
4	9 Sagittarii	88	84	88	Oct. 28	c¹ Capricor.	319	308	323
30	B. A. C. 5641	70	74	72	28	c¹ Capricor.	13	3	18
Apr. 1	ν² Sagittarii	91	81	91	Nov. 29	54 Ceti	210	189	205
2	f Sagittarii	91	77	91	Dec. 1	148 B. Tauri	273	264	274
26	19 Scorpii	70	77	72	1885, Jan. 4	48 Leonis	107	124	106
May 26	ο Sagittarii	274	263	274	Mar. 4	κ Virginis	108	122	107
June 13	83 B. Leonis	212	230	207	Apr. 2	γ Libræ	239	247	236
13	89 B. Leonis	285	309	286	2	γ Libræ	133	140	130
13	89 B. Leonis	92	115	92	4	125 B. Ophiuchi	22	31	27
14	34 Sextantis	275	300	275	May 5	16 B. Capricor.	33	27	37
18	43 H. Virginis	254	269	252	5	β Capricor.	28	22	32
20	19 Scorpii	294	302	296	22	τ Leonis	286	306	288
21	39 Ophiuchi	285	286	286	24	θ Virginis	282	301	283
25	c¹ Capricor.	282	261	283	June 23	γ Libræ	243	252	241
25	c¹ Capricor.	50	30	53	25	125 B. Ophiuchi	264	268	264
30	4 Arietis	46	112	49	25	164 B. Ophiuchi	241	242	238
July 19	4 Sagittarii	42	129	46	28	54 Sagittarii	146	134	142
19	1 Sagittarii	294	291	296	July 1	θ Aquarii	64	50	66
20	ο Sagittarii	269	259	269	26	β Capricor.	223	210	219
20	ο Sagittarii	102	90	101	26	β Capricor.	128	116	125
27	η Piscium	76	57	77	1886, Jan. 14	38 Arietis	269	255	269
30	36 Tauri	27	24	31	Feb. 9	122 G. Piscium	210	188	205
Aug. 16	28 Sagittarii	264	254	263	13	m Tauri	204	193	199
16	30 Sagittarii	290	283	292	14	71 Orionis	255	253	254
16	31 Sagittarii	265	254	264	May 14	46 Virginis	275	294	275
Oct. 7	δ Scorpii	216	220	212	16	ξ Libræ	278	294	279
10	π Sagittarii	308	300	311	21	ρ Sagittarii	298	297	301
10	π Sagittarii	25	18	29	21	ρ Sagittarii	58	56	60
Dec. 12	26 Arietis	252	234	250	June 6	o¹ Cancri	255	265	254
1881, Mar. 8	1 Geminor.	348	358	353	10	γ Virg. N)	233	249	230
18	40 H. Virginis	142	154	138	10	γ Virg. S)	273	292	273
Oct. 3	19 Aquarii	231	209	228	10	γ Virg. N)	107	125	106
31	138 B. Aquarii	271	250	271	10	γ Virg. S)	107	125	106
Nov. 1	3 Piscium	221	195	217	15	125 B. Ophiuchi	297	305	299
Dec. 24	ξ Aquarii	239	216	236	July 8	66 Virginis	313	335	317
27	d Piscium	266	245	266	Aug. 24	71 Orionis	49	51	52
1882, Feb. 7	χ Virginis	106	125	105	Sept. 5	164 B. Ophiuchi	293	300	295
11	ω² Scorpii	80	88	81	Oct. 7	18 Aquarii	270	257	270
12	116 B. Ophiuchi	95	96	95	Nov. 1	ρ Sagittarii	255	250	254
Mar. 8	621 B. Virginis	81	98	82	12	64 Tauri	121	109	119
Apr. 20	247 B. Tauri	305	304	308	14	68 Orionis	126	121	123
May 6	16 Sagittarii	79	74	80	Dec. 6	μ Piscium	255	236	254
29	621 B. Virginis	273	289	273	1887, Jan. 11	7 Leonis	127	137	124
June 4	g Sagittarii	138	121	134	19	78 B. Ophiuchi	124	130	121
July 2	β Capricor.	349	339	354	Feb. 1	3 B. Tauri	294	281	296
21	χ Virginis	256	275	255	4	57 Orionis	237	230	234
Aug. 18	50 Virginis	252	268	250	18	246 B. Sagittarii	47	47	50
27	19 Aquarii	281	264	282	Mar. 14	φ Ophiuchi	33	47	37
27	ξ Aquarii	203	180	198	31	68 Orionis	277	275	278
Sept. 7	5 Cancri	42	59	46	Apr. 4	α Leonis	298	315	300

* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m′	Date.	Star.	m*	m_1	m′
		°	°	°			°	°	°
1887, Apr. 4	α Leonis	76	92	77	1890, Mar. 14	117 B. Sagittarii	118	118	116
6	b Virginis	260	278	259	Apr. 7	30 Libræ	115	132	113
9	18 Libræ	125	138	122	15	ψ^3 Aquarii	100	77	99
15	47 B. Capricor.	56	50	59	28	η Leonis	300	321	303
15	61 B. Capricor.	136	124	133	May 9	329 B. Sagittarii	138	127	134
May 1	ψ Leonis	269	282	269	30	566 B. Virginis	296	322	298
June 3	18 Libræ	271	287	271	June 4	24 Sagittarii	85	88	85
13	4 Ceti	24	9	28	5	53 Sagittarii	132	125	129
13	5 Ceti	36	21	40	5	274 B. Sagittarii	132	125	129
July 29	φ Ophiuchi	300	314	303	6	17 Capricor.	80	70	81
Aug. 1	190 B. Sagittarii	298	299	300	July 21	ω Virginis	283	307	284
1	d Sagittarii	230	224	226	Aug. 26	208 B. Sagittarii	253	249	251
5	64 Aquarii	72	57	73	Sept. 1	f Piscium	68	46	70
14	χ^2 Orionis	112	106	110	30	31 Arietis	108	85	107
Sept. 3	27 Piscium	47	31	50	Oct. 24	351 B. Aquarii	202	173	197
3	29 Piscium	74	56	75	Nov. 17	36 B. Capricor.	246	233	244
13	θ Cancri	44	55	47	20	ψ^3 Aquarii	263	239	262
Nov. 7	δ Cancri	73	84	74	Dec. 1	79 Cancri	169	177	164
21	42 Capricor.	235	218	232	23	53 Tauri	324	313	328
22	σ Aquarii	227	207	223	1891, Feb. 20	λ Cancri	305	318	308
22	58 Aquarii	300	286	303	21	90 H^1. Cancri	283	298	284
24	4 Ceti	284	265	285	Mar. 15	56 Tauri	330	320	335
24	5 Ceti	276	257	277	19	ω^1 Cancri	196	201	191
24	19 B. Ceti	245	223	243	19	ω^2 Cancri	276	285	277
Dec. 17	ρ Capricor.	270	261	270	May 4	54 B. Ceti	92	66	92
17	34 B. Capricor.	284	276	285	14	ξ Cancri	284	300	285
1888, Jan. 15	μ Capricor.	274	259	274	14	79 Cancri	271	285	271
27	85 Geminor.	328	338	332	28	φ Capricor.	132	114	129
Mar. 9	44 Capricor.	133	117	130	July 18	157 B. Ophiuchi	276	287	277
9	45 Capricor.	27	17	31	18	Pi. XVII 31	322	336	326
18	δ Tauri	303	294	306	18	39 Ophiuchi	323	337	327
25	l Leonis	342	5	347	22	ε Capricor.	38	25	42
July 17	ξ Libræ	306	327	309	Aug. 14	22 Ophiuchi	282	295	283
17	18 Libræ	211	225	207	18	χ Capricor.	267	253	267
20	16 G. Sagittarii	261	265	260	20	ψ^1 Aquarii	134	107	131
21	36 Sagittarii	220	216	216	20	ψ^2 Aquarii	50	28	53
21	ξ Sagittarii	323	327	327	24	σ Arietis	10	353	15
21	ξ Sagittarii	29	33	33	Oct. 12	φ Capricor.	237	218	234
23	19 Capricor.	95	105	95	14	ψ^1 Aquarii	225	196	221
23	21 Capricor.	134	120	131	14	ψ^2 Aquarii	298	276	301
23	θ Capricor.	95	84	95	Nov. 6	σ Sagittarii	285	285	286
25	70 Aquarii	155	133	151	6	σ Sagittarii	100	82	99
28	35 Ceti	98	75	97	19	υ Geminor.	121	125	119
Aug. 17	121 B. Sagittarii	320	325	324	1892, Feb. 23	σ Sagittarii	82	81	83
Sept. 13	15 Sagittarii	247	249	245	May 13	26 Ophiuchi	50	64	53
13	21 Sagittarii	224	222	220	July 4	α Libræ	254	275	252
Oct. 9	29 Ophiuchi	230	236	227	6	ρ Oph. (N).	295	311	297
15	70 Aquarii	259	240	258	6	ρ Oph. (S).	295	312	297
Nov. 15	ν Piscium	304	286	307	11	χ Capricor.	168	147	163
Dec. 20	μ Cancri	87	93	87	Aug. 3	88 B. Ophiuchi	208	214	203
1889, Jan. 8	35 Ceti	334	317	339	Sept. 6	ψ^1 Aquarii	265	239	265
14	141 Tauri	210	199	205	11	33 Tauri	145	124	141
Feb. 5	ν Piscium	330	313	335	Dec. 12	46 Virginis	104	130	103
Mar. 10	η Geminor.	296	295	298	1893, Mar. 25	ι Geminor.	285	293	286
11	44 Geminor.	326	331	330	Apr. 23	79 Cancri	289	309	291
23	14 Sagittarii	96	100	96	May 8	ε Capricor.	60	42	62
Apr. 20	30 Sagittarii	70	73	72	June 24	28 G. Libræ	296	321	298
20	31 Sagittarii	138	134	134	July 1	χ Capricor.	98	79	97
June 5	167 B. Leonis	288	309	290	6	ζ Piscium	68	47	70
5	46 Leonis	237	252	234	Aug. 2	171 B. Piscium	125	94	122
10	13 Libræ	299	222	302	21	3 Sagittarii	258	261	257
July 19	64 Ceti	87	66	87	Sept. 3	β Tauri	201	189	196
Aug. 8	168 B. Sagittarii	328	333	333	23	70 Aquarii	251	220	246
Sept. 4	ν^2 Sagittarii	328	333	333	Oct. 20	50 Aquarii	265	235	260
30	190 B. Ophiuchi	255	263	254	26	23 Tauri	36	14	31
Nov. 29	74 Aquarii	255	234	254	26	20 Tauri	139	117	134
Dec. 1	15 Ceti	200	171	195	Nov. 19	44 Piscium	288	254	283
29	33 Ceti	314	295	318	24	β Tauri	292	280	287
31	38 Arietis	231	207	228	24	β Tauri	81	70	76
1890, Feb. 12	θ Libræ	125	139	122	Dec. 20	9 Tauri	322	299	327

*See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m′
		°	°	°
1893, Dec. 20	17 Tauri	280	258	275
20	16 Tauri	239	219	236
20	20 Tauri	231	211	228
1894, Jan. 18	β Tauri	286	281	287
Feb. 28	10 G. Sagittarii	124	123	121
Mar. 16	φ Geminor.	287	301	289
31	χ Capricor.	31	16	35
Apr. 24	38 B. Sagittarii	63	66	65
25	τ Sagittarii	104	97	103
29	50 Aquarii	41	20	45
29	182 B. Aquarii	24	2	28
May 2	147 B. Piscium	51	25	54
21	10 G. Sagittarii	154	152	150
July 15	38 B. Sagittarii	315	320	319
Aug. 4	β Virginis	293	324	295
Sept. 21	116 B. Aurigæ	30	30	34
Dec. 2	η Capricor.	254	233	253
1895, Jan. 20	α Scorpii	315	330	319
20	α Scorpii	62	75	64
Feb. 6	28 Geminor.	242	244	239
6	53 Aurigæ	292	298	294
13	α Virginis	31	62	35
18	38 B. Sagittarii	86	85	86
Apr. 3	ω¹ Cancri	339	358	344
May 6	g Virginis	210	234	205
July 30	48 B. Scorpii	286	299	287
1896, Jan. 7	ι Virginis	79	101	76
31	ρ Leonis	68	90	63
Mar. 8	h Sagittarii	120	112	123
Apr. 7	μ Capricor.	85	65	90
22	α Leonis	295	316	290
25	ψ Virginis	286	309	282
May 1	σ Sagittarii	222	218	226
1	σ Sagittarii	147	142	150
20	ρ Leonis	307	328	302
26	α Scorpii	224	234	225
26	α Scorpii	116	126	117
June 19	ψ Virginis	307	330	304
22	A Scorpii	272	284	272
July 31	ι Arietis	109	89	111
Aug. 20	4 Capricor.	274	262	278
Sept. 5	α Leonis	218	239	213
18	42 Capricor.	278	259	283
Oct. 9	α Scorpii	246	255	247
10	α Scorpii	130	140	132
Nov. 9	χ Sagittarii	324	316	328
9	χ Sagittarii	7	359	11
9	49 Sagittarii	194	186	198
1897, Jan. 17	A Geminor.	337	344	332
23	χ Virginis	167	190	164
27	α Scorpii	333	342	335
27	α Scorpii	46	55	48
Feb. 13	39 Geminor.	347	352	343
23	α Scorpii	83	92	85
Apr. 14	79 Leonis	282	306	278
19	σ Scorpii	68	78	70
May 5	136 Tauri	244	243	240
July 3	18 Leonis	337	356	332
12	λ Sagittarii	210	208	214
Aug. 4	83 Virginis	255	276	255
Sept. 9	ρ Aquarii	306	285	310
18	136 Tauri	166	165	162
Oct. 1	A Ophiuchi	278	283	282
8	16 Piscium	217	194	220
Nov. 4	κ Piscium	260	237	264
4	9 Piscium	301	278	304
Dec. 5	θ Arietis	249	230	248
13	π Cancri	77	94	72
1898, Jan. 10	18 Leonis	106	125	102
10	19 Leonis	88	107	83

Date.	Star.	m	m_1	m′
		°	°	°
1898, Feb. 13	42 Libræ	114	128	117
25	θ Arietis	294	274	293
Mar. 2	ε Geminor.	290	294	286
5	π Cancri	246	262	241
17	ρ Capricor.	127	114	132
Apr. 25	139 Tauri	312	311	307
28	θ Cancri	326	339	321
May 16	75 Piscium	91	69	91
June 6	50 Sagittarii	64	56	69
13	105 Piscium	128	106	127
30	42 Libræ	306	320	309
Aug. 6	75 Piscium	10	347	9
25	26 Ophiuchi	195	201	199
Sept. 3	η Piscium	83	62	82
23	ν¹ Sagittarii	288	283	293
23	ν² Sagittarii	289	284	294
Oct. 20	23 Sagittarii	213	211	218
24	51 Aquarii	263	242	266
Nov. 16	1 Sagittarii	276	275	280
Dec. 30	o¹ Cancri	158	174	154
1899, Feb. 2	43 H. Virginis	43	62	45
4	27 G. Scorpii	54	66	58
21	79 Geminor.	282	291	276
Mar. 16	26 Tauri	271	258	267
16	27 Tauri	212	200	208
May 1	31 B. Capricor.	97	83	101
3	44 Aquarii	104	83	106
12	132 Tauri	230	228	225
June 13	o Leonis	224	243	221
25	τ Capricor.	78	63	82
July 18	δ Scorpii	179	191	183
18	δ Scorpii	159	171	164
Aug. 26	66 Arietis	149	135	145
27	62 Tauri	118	108	113
Oct. 11	36 Sagittarii	254	249	259
27	o Leonis	92	110	89
Nov. 11	187 B. Aquarii	248	226	249
13	36 Piscium	246	222	245
14	75 Piscium	204	182	202
18	99 Tauri	101	94	96
Dec. 8	138 B. Aquarii	216	196	218
13	μ Arietis	256	239	252
1900, Jan. 23	40 H. Virginis	139	159	143
Feb. 3	d Piscium	324	300	322
12	90 B. Cancri	274	288	270
Mar. 7	300 B. Tauri	221	213	216
8	394 B. Tauri	286	283	281
23	14 Sagittarii	67	66	72
26	ν Aquarii	113	97	116
Apr. 2	τ Arietis	262	247	257
5	η Geminor.	264	265	259
May 16	52 Ophiuchi	74	77	79
16	158 G. Ophiuchi	105	108	110
16	58 Ophiuchi	129	131	134
20	19 Aquarii	100	83	102
June 8	550 B. Virginis	211	233	215
14	45 Sagittarii	126	118	130
July 6	40 H. Virginis	279	298	283
10	58 Ophiuchi	247	250	252
Aug. 7	μ Sagittarii	264	264	269
8	d Sagittarii	287	280	291
17	A Tauri	146	135	141
Sept. 1	ω² Scorpii	233	244	238
2	116 B. Ophiuchi	257	262	262
4	171 B. Sagittarii	324	318	328
28	λ Libræ	234	247	239
Nov. 13	h Leonis	24	42	23
26	g Sagittarii	251	240	254
Dec. 5	67 Tauri	239	229	234
9	23 H¹. Cancri	72	85	70

* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		$^\circ$	$^\circ$	$^\circ$			$^\circ$	$^\circ$	$^\circ$
1901, Jan. 28	22 H^1. Tauri	242	229	237	1903, Dec. 31	68 Tauri	238	232	240
Feb. 15	ρ Sagittarii	94	86	97	1904, Mar. 4	l Virginis	129	151	134
25	247 B. Tauri	252	242	246	Apr. 22	2 B. Cancri	290	302	293
26	o Tauri	244	240	239	May 1	φ Ophiuchi	98	107	100
Mar. 10	28 Libræ	107	123	112	24	η Virginis	266	289	271
25	105 Tauri	252	246	247	June 4	ρ Aquarii	121	100	116
28	5 Cancri	233	244	231	July 7	38 Arietis	101	83	98
Apr. 4	α Virginis	287	308	291	18	38 Virginis	325	348	330
4	α Virginis	77	99	81	22	φ Ophiuchi	283	292	284
7	56 B. Scorpii	78	90	83	Sept. 13	13 Libræ	278	295	281
7	β Scorpii	78	89	83	22	67 Aquarii	303	281	298
10	89 G. Sagittarii	36	33	40	Oct. 27	m Tauri	124	118	124
24	f Geminor.	239	248	236	Dec. 16	77 Piscium	248	225	244
May 5	123 B. Scorpii	69	77	74	1905, Jan. 26	80 Virginis	72	93	76
June 5	g Sagittarii	91	79	93	Mar. 17	o^1 Cancri	247	263	252
12	19 Arietis	51	31	46	Apr. 16	σ Leonis	211	234	216
22	p^5 Leonis	336	1	341	24	ρ Sagittarii	112	105	109
25	α Virginis	296	315	298	May 10	ζ Cancri	245	257	249
25	α Virginis	78	97	80	10	Pi. VIII 6	245	257	249
July 10	ρ Arietis	101	88	100	July 7	σ Leonis	340	4	345
Aug. 9	ζ Tauri	108	105	104	20	337 B. Aquarii	134	111	129
19	86 Virginis	244	266	249	Aug. 7	15 Libræ	300	317	301
22	ν Scorpii	264	275	269	Sept. 12	λ Aquarii	226	204	221
30	κ Piscium	67	44	64	12	λ Aquarii	122	100	117
Sept. 25	30 Aquarii	315	295	314	Dec. 2	37 Aquarii	200	180	196
Oct. 21	16 B. Aquarii	304	288	304	10	64 Tauri	210	200	210
29	129 H^1. Tauri	114	105	109	1906, Mar. 3	m Tauri	335	329	338
Nov. 16	283 B. Sagittarii	212	203	214	4	57 Orionis	244	244	247
Dec. 18	19 Piscium	260	237	256	17	Y Sagittarii	152	150	148
22	175 B. Arietis	244	229	239	20	29 Capricor.	86	69	81
1902, Jan. 18	53 Arietis	232	216	227	Apr. 2	61 Geminor.	198	206	202
19	43 Tauri	344	332	339	10	18 Libræ	107	124	107
31	ν Libræ	92	108	97	14	190 B. Sagittarii	121	115	117
Feb. 17	χ^1 Orionis	283	282	280	May 9	φ Ophiuchi	114	123	112
Mar. 20	k Leonis	290	308	291	17	4 Ceti	133	109	129
25	k Virginis	68	89	73	June 4	18 Libræ	255	271	255
28	73 B. Scorpii	69	81	74	July 8	μ Capricor.	104	85	100
29	29 Ophiuchi	154	160	158	Aug. 9	ν Piscium	61	40	60
May 10	57 Orionis	308	307	306	Sept. 5	f Piscium	136	114	134
12	1 Cancri	342	352	341	Oct. 28	27 Piscium	230	206	226
June 10	k Leonis	299	318	301	Dec. 19	45 Capricor.	274	255	269
17	32 Libræ	245	259	250	1907, Jan. 27	63 Geminor.	246	254	251
July 11	261 B. Virginis	295	318	300	Feb. 1	ν Virginis	103	126	106
11	f Virginis	295	319	300	16	f Piscium	260	238	259
18	100 B. Sagittarii	274	271	276	21	351 B. Tauri	295	290	298
Nov. 6	283 B. Sagittarii	244	234	244	25	139 B. Cancri	311	326	316
17	57 Orionis	120	119	118	Mar. 10	19 Capricor.	83	67	78
1903, Feb. 7	352 B. Tauri	248	244	246	Apr. 25	c Virginis	316	340	318
19	24 Scorpii	88	96	91	June 18	ν Virginis	317	340	320
Mar. 5	173 B. Tauri	346	334	342	July 23	33 Sagittarii	242	237	237
Apr. 4	74 B. Geminor.	318	322	317	23	π Sagittarii	247	241	242
Aug. 1	η Libræ	259	272	263	26	39 Aquarii	55	34	51
Sept. 2	54 Sagittarii	323	314	322	Sept. 15	30 G. Sagittarii	293	293	288
2	e Sagittarii	299	290	298	16	o Sagittarii	283	277	278
Oct. 22	γ Libræ	218	231	221	19	39 Aquarii	288	267	284
Dec. 31	119 H^1. Tauri	285	276	283	19	45 Aquarii	268	248	265

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1902, Oct. 22	λ Geminor.	124	131	124	1904, Sept. 29	γ Tauri	124	114	123
Nov. 20	60 Cancri	96	111	97	29	θ^1 Tauri	82	72	81
1903, Jan. 14	α Cancri	111	126	112	29	θ^2 Tauri	61	51	59
Mar. 8	51 Geminor.	327	334	327	Nov. 20	64 Ceti	297	277	294
June 2	p^4 Leonis	295	317	299	20	ξ^1 Ceti	274	254	271
Oct. 30	ρ Aquarii	204	183	199	Dec. 20	γ Tauri	100	90	100
1904, July 9	θ^1 Tauri	80	70	78	20	75 Tauri	233	223	232

CRACOW.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1825, Dec. 14	c^1 Capricor.	306	288	311	1839, Oct. 19	φ Aquarii	286	264	286
1827, July 2	49 Virginis	300	322	298	19	96 Aquarii	290	267	291
Aug. 1	41 Libræ	296	309	296	Nov. 14	ι Aquarii	262	243	267
29	58 G. Scorpii	304	314	309	1840, Jan. 13	μ Arietis	322	305	325
1828, Feb. 22	68 Tauri	296	286	293	14	q Tauri	313	301	314
June 16	κ Cancri	272	288	267	14	21 Tauri	300	288	301
1829, Apr. 12	α Cancri	311	326	307	14	22 Tauri	308	296	309
June 13	μ Libræ	300	317	304	16	406 B. Tauri	255	253	253
Dec. 9	α Tauri	269	260	264	Apr. 11	ν Leonis	318	337	313
1830, Mar. 2	130 Tauri	237	235	232	Sept. 3	τ Scorpii	284	292	285
3	26 Geminor.	237	240	232	1841, Feb. 27	7 Tauri	212	199	211
Apr. 28	1 Cancri	297	307	294	Apr. 28	π Cancri	325	341	320
May 1	48 Leonis	246	267	245	Sept. 22	66 B. Sagittarii	216	215	220
June 4	η Libræ	232	245	237	1842, Mar. 22	o^2 Cancri	257	272	252
25	o Sextantis	291	312	290	22	o^1 Cancri	314	329	309
July 16	α Tauri	222	213	216	May 14	63 Geminor.	290	297	285
Aug. 1	110 B. Sagittarii	248	246	246	1843, Mar. 6	47 Arietis	272	256	269
Oct. 20	24 Scorpii	228	236	233	May 3	1 Geminor.	269	269	263
23	d Sagittarii	272	266	276	3	3 Geminor.	236	236	231
Dec. 22	29 Piscium	305	282	303	3	4 Geminor.	257	257	252
1831, Jan. 20	ν Piscium	290	269	286	9	e Leonis	221	244	219
22	f Tauri	335	321	330	June 3	h Leonis	247	264	244
Feb. 19	48 Tauri	272	261	267	Nov. 2	κ Piscium	253	230	254
19	γ Tauri	255	244	250	2	9 Piscium	290	267	291
June 21	γ Libræ	233	247	239	1844, Apr. 26	ω Leonis	284	301	281
Oct. 23	α Tauri	307	298	302	1845, Jan. 12	κ Piscium	257	234	256
23	α Tauri	46	37	41	12	9 Piscium	293	270	291
Dec. 17	γ Tauri	284	274	279	Apr. 12	68 Orionis	267	267	263
1832, Jan. 5	θ Capricor.	269	254	269	May 20	25 Libræ	296	311	301
Feb. 10	α Tauri	294	285	289	Sept. 13	c^1 Capricor.	278	260	278
10	α Tauri	53	44	48	Nov. 6	ν Aquarii	223	207	223
15	α Leonis	267	286	269	9	22 Piscium	269	246	266
Mar. 8	75 Tauri	285	275	280	1846, May 4	14 Sextantis	258	278	260
9	119 Tauri	273	269	269	1848, Feb. 15	λ Geminor.	302	309	304
Sept. 4	o Sagittarii	294	289	296	May 9	35 Leonis	192	208	195
Dec. 31	311 B. Piscium	283	262	283	1849, Jan. 3	64 Ceti	270	250	267
1833, Mar. 31	8 Leonis	207	224	210	3	ξ^2 Ceti	250	231	246
1834, Apr. 13	330 B. Tauri	217	211	222	Apr. 5	β Virginis	251	274	256
20	ν Virginis	224	247	229	Oct. 25	73 B. Aquarii	249	232	244
Oct. 7	33 Scorpii	296	300	296	1850, Apr. 15	264 B. Tauri	311	301	312
7	44 Ophiuchi	274	278	274	15	α Tauri	267	258	269
8	λ Sagittarii	271	269	270	16	120 Tauri	215	212	217
Nov. 3	24 Ophiuchi	268	275	268	21	ρ Leonis	318	339	323
1835, Jan. 6	35 Ceti	225	203	228	22	σ Leonis	243	266	248
Apr. 9	46 Leonis	256	276	261	Aug. 14	γ Libræ	263	277	262
June 10	θ Ophiuchi	254	258	253	1851, Jan. 15	64 Orionis	261	260	265
July 6	λ Libræ	228	240	228	Mar. 13	d^1 Cancri	302	314	307
Aug. 29	26 Libræ	289	304	290	Aug. 2	80 Virginis	285	306	285
Oct. 3	69 Aquarii	255	234	250	Sept. 4	28 Sagittarii	282	278	277
Nov. 25	35 Capricor.	271	255	266	Dec. 5	87 Ceti	301	283	302
1836, Feb. 23	14 Tauri	248	235	253	1852, Jan. 4	i Tauri	224	217	228
25	118 Tauri	280	276	283	6	d Geminor.	236	240	241
Mar. 24	139 Tauri	317	316	320	Mar. 30	98 B. Cancri	317	330	322
Apr. 25	η Leonis	208	227	213	30	102 B. Cancri	279	292	284
1837, Feb. 14	112 B. Aurigæ	230	227	234	30	107 B. Cancri	289	302	293
Mar. 15	47 Geminor.	286	288	291	Apr. 25	δ Geminor.	334	341	339
16	ω Cancri	276	286	281	27	83 Cancri	323	339	327
May 10	λ Cancri	310	321	315	28	37 Leonis	327	347	330
June 6	4 Cancri	238	248	239	Aug. 25	49 Sagittarii	289	282	284
Nov. 10	54 Ceti	306	285	307	Sept. 18	ν Scorpii	281	292	276
1838, Jan. 3	88 Piscium	274	252	274	Oct. 24	30 Piscium	225	202	225
Feb. 4	107 B. Aurigæ	270	267	273	1853, Feb. 18	1 Geminor.	251	251	256
Mar. 1	τ Arietis	315	301	318	May 12	42 Geminor.	237	242	242
June 4	40 H. Virginis	333	352	328	20	95 Virginis	239	259	236
Sept. 2	κ Capricor.	295	278	292	July 17	157 B. Ophiuchi	286	291	281
Oct. 25	A Sagittarii	215	205	210	1854, Jan. 7	ξ Arietis	287	268	291
Nov. 27	171 B. Piscium	301	278	306	Mar. 3	31 Arietis	291	273	296
Dec. 26	27 Arietis	246	228	250	July 7	18 Ophiuchi	304	311	299
1839, July 23	W Sagittarii	320	320	321	31	m Virginis	316	337	312
Aug. 25	φ Aquarii	270	248	270	Sept. 30	ω Sagittarii	272	263	270
Oct. 18	58 Aquarii	255	234	254	30	A Sagittarii	291	281	289

DORCHESTER, MASS.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1825, July 27	o Sagittarii	321	316	326	1831, Feb 19	α Tauri	207	198	207
27	o Sagittarii	34	29	39	Aug. 28	f Tauri	308	294	308
27	π Sagittarii	206	201	210	29	γ Tauri	230	220	231
1827, Feb. 10	α Cancri	215	230	214	29	γ Tauri	116	106	117
Nov. 16	α Virginis	249	271	254	29	α Tauri	273	264	275
28	ε Piscium	277	255	272	29	θ^1 Tauri	300	290	302
1828, Jan. 31	60 Cancri	222	237	223	29	θ^2 Tauri	338	328	339
Aug. 16	λ Virginis	293	312	299	29	θ^2 Tauri	7	357	8
1829, Aug. 21	α Tauri	247	238	245	Oct. 14	π Capricor.	242	230	237
21	α Tauri	106	97	104	23	α Tauri	244	235	245
Sept. 17	α Tauri	286	277	284	23	α Tauri	104	95	106
23	o Leonis	321	339	325	1832, June 17	δ Capricor.	332	314	327
23	o Leonis	26	44	30	17	δ Capricor.	29	11	24
Nov. 11	α Tauri	326	317	325	Sept. 7	δ Capricor.	308	290	304
11	α Tauri	46	37	44	7	δ Capricor.	53	35	48
1830, Jan. 5	α Tauri	315	306	313	1839, Apr. 20	γ Cancri	307	320	304
Mar. 28	α Tauri	252	243	251	June 19	28 Virginis	357	20	352
28	α Tauri	109	100	108	20	68 Virginis	244	265	240
July 15	α Tauri	216	207	216	23	b Scorpii	265	277	263
Oct. 4	f Tauri	333	319	331	July 1	φ Aquarii	243	221	249
4	f Tauri	19	5	17	1	φ Aquarii	88	66	93
1831, Jan. 21	μ Ceti	314	296	312	Nov. 20	17 Tauri	256	244	258
Feb. 4	γ Libræ	297	311	298	20	20 Tauri	224	212	225
4	γ Libræ	76	90	77	20	η Tauri	312	300	314
19	θ^1 Tauri	289	279	289	Dec. 12	λ Aquarii	251	263	256
19	θ^2 Tauri	312	302	313					

DORPAT.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1812, Oct. 21	f Tauri	300	286	300	1822, Feb. 27	q Tauri	340	328	339
21	f Tauri	52	38	51	27	21 Tauri	319	307	318
Dec. 16	γ Tauri	242	232	242	27	q Tauri	24	12	24
16	γ Tauri	109	99	110	May 1	υ Leonis	210	233	205
16	θ^2 Tauri	312	302	312	1	υ Leonis	175	198	171
16	264 B. Tauri	266	256	267	Aug. 10	17 Tauri	71	58	70
16	α Tauri	260	251	261	10	16 Tauri	109	96	108
1813, Apr. 8	ζ Cancri	262	273	267	10	20 Tauri	243	231	242
8	ζ Cancri	95	106	100	10	q Tauri	153	141	152
10	ν Leonis	258	277	263	10	η Tauri	330	318	329
10	ν Leonis	99	118	104	10	22 Tauri	157	145	156
1814, Feb. 1	ν Geminor.	263	265	267	10	20 Tauri	112	100	111
1816, Apr. 12	κ Virginis	258	277	255	10	η Tauri	23	11	22
1819, Sept. 8	ζ Arietis	230	215	235	Oct. 31	23 Tauri	276	264	275
Oct. 9	49 Aurigæ	269	271	270	31	η Tauri	261	249	260
1820, Apr. 23	χ Leonis	210	232	205	31	23 Tauri	75	63	74
Aug. 28	47 Arietis	241	225	244	31	27 Tauri	295	283	294
28	47 Arietis	98	82	101	31	η Tauri	90	78	89
1821, Feb. 6	62 Piscium	261	238	266	31	27 Tauri	55	43	54
6	δ Piscium	212	189	216	Nov. 30	ε Geminor.	267	270	262
6	δ Piscium	38	15	43	Dec. 25	17 Tauri	263	250	261
May 6	κ Geminor.	272	280	269	25	16 Tauri	223	210	222
July 22	μ Arietis	228	211	230	25	20 Tauri	222	210	220
23	16 Tauri	265	252	266	25	η Tauri	303	291	301
23	17 Tauri	305	292	306	25	η Tauri	48	36	47
23	q Tauri	235	223	236	25	28 Tauri	330	318	328
23	20 Tauri	266	254	267	1823, Jan. 24	ε Geminor.	277	280	273
23	21 Tauri	228	216	229	24	ε Geminor.	91	94	87
23	17 Tauri	41	28	42	Sept. 23	μ Arietis	103	86	102
23	16 Tauri	81	69	82	1824, Sept. 4	ρ Capricor.	306	294	311
23	20 Tauri	79	67	80	1825, Jan. 3	1 Geminor.	228	227	223
Dec. 7	q Tauri	258	266	258	Feb. 27	η Geminor.	251	251	246
7	17 Tauri	349	337	349	Mar. 24	A Tauri	285	274	280
7	17 Tauri	2	350	2	24	39 Tauri	302	291	297
7	21 Tauri	251	239	251	Sept. 23	c^2 Capricor.	246	228	247
7	q Tauri	94	82	94	1826, Feb. 15	53 Tauri	298	288	293
1822, Feb. 8	υ Leonis	289	312	284	16	105 Tauri	280	274	275
8	υ Leonis	94	117	90					

ENGELHARDT (NEAR KASAN).

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1904, Feb. 29	o Leonis	261	280	266	1904, Dec. 20	θ^2 Tauri	36	27	36
29	o Leonis	100	119	104	1905, Apr. 12	162 B. Geminor.	286	295	290
Mar. 22	γ Tauri	334	324	332	12	162 B. Geminor.	76	85	80
27	209 B. Cancri	24	40	27	July 13	29 Ophiuchi	316	322	314
Apr. 28	m Virginis	219	240	223	Oct. 11	5 Ceti	188	164	183
Dec. 20	48 Tauri	308	297	307	11	5 Ceti	159	144	154
20	γ Tauri	310	300	310	1906, Dec. 25	ξ^2 Ceti	229	210	230
20	θ^1 Tauri	302	293	302	1907, Mar. 21	B. D.+19° 1110	305	304	310
20	θ^2 Tauri	331	322	331	Sept. 18	η Capricor.	18	2	14

EVANSTON.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1897, Aug. 9	χ Sagittarii	296	290	301	1898, Feb. 5	o^2 Cancri	278	294	273
14	λ Piscium	224	201	228	25	26 Arietis	272	253	270
Oct. 3	53 Sagittarii	263	254	268	Apr. 2	10 Sextantis	303	323	299
30	49 Sagittarii	314	306	319	1900, Sept. 12	44 Arietis	110	92	105
Dec. 5	26 Arietis	209	190	208	1901, Oct. 19	ρ Sagittarii	241	234	244
25	o Capricor.	176	163	182	24	λ Piscium	222	199	219
27	θ Aquarii	199	178	203	Dec. 19	62 Piscium	303	280	299
1898, Jan. 5	125 Tauri	240	237	236	21	o Arietis	315	297	310
26	45 Piscium	322	299	324					

GÖTTINGEN.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1868, Feb. 29	f Tauri	336	322	335	1891, Feb. 12	29 Ceti	293	272	296
Mar. 1	θ^1 Tauri	257	247	257	Apr. 20	ν Virginis	256	279	255
1	θ^2 Tauri	277	267	277	25	41 Libræ	85	98	80
1	264 B. Tauri	214	204	214	25	κ Libræ	305	318	300
1	85 Tauri	307	297	306	25	κ Libræ	84	97	79
Sept. 8	α Tauri	222	212	222	May 10	121 Tauri	312	309	317
8	α Tauri	134	124	134	Oct. 15	30 Piscium	325	301	327
1869, Aug. 2	α Tauri	65	56	67	15	30 Piscium	25	1	27
Dec. 8	δ Capricor.	239	220	234	Nov. 7	ω Sagittarii	283	273	280
1870, Feb. 10	m Tauri	322	316	325	10	τ Aquarii	201	179	202
1877, Nov. 20	17 Tauri	23	10	23	10	τ Aquarii	138	116	139
20	q Tauri	244	231	245	1892, Jan. 19	γ Virginis	309	332	305
20	20 Tauri	276	263	277	May 8	θ Virginis	298	320	294
20	20 Tauri	67	54	67	8	θ Virginis	82	104	78
22	136 Tauri	198	196	195	Oct. 3	τ Aquarii	294	272	296
1887, Mar. 8	ρ Leonis	243	264	248	31	ψ^3 Aquarii	200	177	203
8	ρ Leonis	116	137	121	1893, Sept. 1	δ Arietis	148	132	152
1889, Jan. 12	64 Tauri	239	229	243	1894, Mar. 14	136 Tauri	338	337	339
1890, Jan. 3	l Tauri	330	324	335	Apr. 12	c Geminor.	271	280	270
Feb. 7	ν Virginis	269	292	270	1895, June 26	α Leonis	298	318	293
7	ν Virginis	103	126	104	26	α Leonis	80	100	75
14	4 Sagittarii	157	158	152	Sept. 29	δ Capricor.	263	244	268
14	7 Sagittarii	303	303	298	30	σ Aquarii	197	176	202
June 29	β Scorpii	92	104	87	Nov. 27	62 Piscium	290	267	294
July 12	ε Tauri	25	15	30	27	δ Piscium	249	226	253

GREENWICH.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1753, Apr. 19	β Scorpii	317	329	321	1764, Feb. 20	α Virginis	113	135	108
Aug. 5	8 Libræ	182	199	188	1765, Feb. 4	γ Cancri	270	283	266
Oct. 5	16 B. Capricor.	235	223	235	4	γ Cancri	102	115	98
5	β Capricor.	239	227	239	Sept. 25	δ Capricor.	277	259	282
5	β Capricor.	108	96	108	Oct. 2	q Tauri	294	281	295
1754, Apr. 2	κ Cancri	268	283	270	2	18 Tauri	206	193	207
Nov. 21	ρ Aquarii	278	268	274	1766, Sept. 22	17 Tauri	330	317	329
1755, July 18	θ Libræ	311	324	313	22	20 Tauri	279	266	279
1757, Feb. 25	α Tauri	118	109	120	1767, Sept. 12	η Tauri	285	272	283
Apr. 3	γ Virginis	316	339	320	12	27 Tauri	327	315	324
3	γ Virginis	53	76	56	12	η Tauri	70	58	68
July 30	19 Capricor.	283	269	278	1768, Jan. 27	23 Tauri	251	238	248
1758, Feb. 17	ν Geminor.	243	244	247	27	η Tauri	197	185	194
1761, Dec. 10	θ^2 Tauri	318	308	318	27	η Tauri	182	170	179
1764, Feb. 20	α Virginis	276	298	271	1769, Sept. 15	16 Piscium	235	212	235

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1769, Sept. 20	67 Tauri	254	244	249	1791, Mar. 16	κ Cancri	262	277	263
20	κ Tauri	231	221	226	Apr. 7	δ Tauri	253	243	249
20	67 Tauri	127	117	122	June 12	λ Virginis	224	243	229
20	κ Tauri	105	95	100	1792, Mar. 27	α Tauri	325	316	322
25	h Leonis	226	243	222	1793, Apr. 19	ξ Leonis	329	346	333
Nov. 18	α Cancri	28	43	25	1794, Mar. 5	μ Ceti	277	259	276
1770, Apr. 7	e Leonis	260	283	261	7	α Tauri	214	205	215
28	ζ Tauri	276	272	271	Aug. 4	γ Libræ	268	282	268
July 19	ζ Tauri	108	104	103	Nov. 8	α Tauri	67	58	69
1771, July 4	δ Piscium	246	223	241	Dec. 18	γ Libræ	100	114	99
4	δ Piscium	116	93	112	1795, May 4	η Libræ	137	150	135
Sept. 18	β Capricor.	228	216	229	July 25	η Libræ	249	262	247
Dec. 24	κ Cancri	90	105	90	Aug. 6	ξ^2 Ceti	196	177	197
1772, May 15	8 Libræ	239	256	244	28	γ Capricor.	257	240	253
15	α Libræ	246	263	251	Oct. 6	δ Cancri	52	65	57
Aug. 17	ζ Piscium	130	108	124	Nov. 24	μ Ceti	243	225	244
Sept. 7	β Capricor.	232	220	231	1796, Aug. 20	33 Piscium	105	82	104
1773, Feb. 6	α Cancri	282	297	284	1797, Dec. 25	33 Piscium	243	220	244
Sept. 7	α Tauri	319	310	317	1798, Aug. 8	ε Geminor.	65	68	69
Nov. 1	α Tauri	296	287	294	1799, Apr. 10	125 Tauri	273	270	277
1774, Nov. 18	α Tauri	96	87	96	21	δ Scorpii	106	118	101
1775, Aug. 1	γ Virginis	112	135	116	1800, May 5	η Virginis	322	345	318
Dec. 12	α Leonis	117	136	123	July 4	43 Ophiuchi	235	239	232
1776, Jan. 29	α Tauri	272	263	274	Nov. 26	ζ Piscium	215	193	220
Mar. 30	α Leonis	240	259	245	1801, Jan. 5	β Virginis	322	345	318
Apr. 6	γ Libræ	212	226	211	5	β Virginis	64	87	60
1777, Nov. 16	ζ Tauri	270	267	275	Mar. 30	α Virginis	297	319	292
16	ζ Tauri	68	65	73	30	α Virginis	87	109	82
1778, Feb. 7	μ Geminor.	219	220	224	Apr. 24	σ Leonis	246	268	241
Dec. 31	ι Tauri	235	229	241	May 24	α Virginis	300	322	295
1779, Feb. 27	γ Cancri	254	267	258	Oct. 23	24 Tauri	231	219	234
Oct. 30	1 Geminor.	52	60	55	23	η Tauri	237	225	240
Dec. 22	132 Tauri	312	310	316	23	23 Tauri	92	80	95
1783, Feb. 9	q Tauri	219	206	222	23	27 Tauri	282	270	285
9	18 Tauri	217	204	220	23	28 Tauri	265	253	268
May 16	π Scorpii	270	282	267	23	27 Tauri	60	48	62
Oct. 7	φ Aquarii	312	290	317	23	28 Tauri	77	65	80
Dec. 6	17 Tauri	297	284	298	1802, Mar. 14	γ Cancri	280	293	276
6	q Tauri	197	184	195	Nov. 3	γ Capricor.	132	115	137
30	δ Piscium	236	213	241	3	δ Capricor.	299	281	304
30	δ Piscium	103	80	107	1803, Mar. 3	κ Geminor.	293	301	289
1784, July 2	τ Sagittarii	305	300	308	3	κ Geminor.	74	82	70
1785, Apr. 11	q Tauri	259	247	259	1804, July 17	π Scorpii	213	224	213
11	17 Tauri	354	341	353	Dec. 14	η Tauri	252	240	250
11	20 Tauri	284	271	283	14	27 Tauri	270	258	267
11	21 Tauri	242	229	241	14	28 Tauri	252	240	249
11	22 Tauri	250	237	249	1805, Aug. 6	λ Sagittarii	280	278	285
June 22	φ Sagittarii	261	258	265	Sept. 7	θ Aquarii	276	256	279
Aug. 16	φ Sagittarii	97	94	102	7	θ Aquarii	66	46	70
1786, Mar. 5	17 Tauri	295	282	293	1807, Dec. 14	ζ Tauri	226	223	222
5	16 Tauri	257	244	255	14	ζ Tauri	121	118	116
5	q Tauri	213	200	211	1808, Oct. 31	δ Piscium	245	222	240
5	20 Tauri	249	236	246	1809, Feb. 27	60 Cancri	250	265	250
Nov. 12	π Leonis	294	313	290	Apr. 3	γ Scorpii	257	268	261
12	π Leonis	91	110	87	3	γ Scorpii	99	110	104
Dec. 9	ξ Leonis	219	236	215	May 28	γ Scorpii	101	112	106
9	ξ Leonis	147	164	143	Sept. 28	64 Tauri	99	89	95
1787, Nov. 26	η Geminor.	279	279	274	Dec. 15	ζ Piscium	308	286	303
26	η Geminor.	88	88	83	1810, Jan. 15	δ Tauri	243	233	239
26	μ Geminor.	203	204	198	15	64 Tauri	269	259	265
26	μ Geminor.	177	178	172	1811, Mar. 1	α Tauri	268	259	266
1788, Oct. 18	i Tauri	297	291	292	1	α Tauri	99	90	97
18	i Tauri	61	55	56	1812, Dec. 14	μ Ceti	288	270	287
Nov. 15	ζ Tauri	329	326	324	1813, Mar. 6	μ Ceti	250	232	249
15	ζ Tauri	30	27	25	Apr. 17	γ Libræ	261	275	260
1789, Nov. 9	κ Cancri	140	155	139	17	γ Libræ	115	129	115
1790, Mar. 5	κ Libræ	321	334	326	Aug. 13	ψ^1 Aquarii	37	15	33
Aug. 17	ν Scorpii	216	227	221	Sept. 14	27 Tauri	66	52	67
Oct. 15	β Capricor.	223	211	223	1814, Oct. 1	μ Ceti	286	268	288
Nov. 17	ε Piscium	257	234	252	1	μ Ceti	57	39	59

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1827, Jan. 14	κ Cancri	293	309	292	1851, Apr. 6	m Tauri	275	270	275
14	κ Cancri	70	86	69	Sept. 14	μ Ceti	110	94	113
19	i Virginis	30	51	35	1852, Feb. 3	63 Geminor.	268	276	273
Dec. 8	ω Leonis	272	289	273	11	30 Libræ	47	62	44
8	ω Leonis	100	117	101	Oct. 24	30 Piscium	211	188	211
1828, Mar. 23	26 Geminor.	256	259	254	24	33 Piscium	245	222	245
24	68 Geminor.	277	285	276	1853, Mar. 26	κ Virginis	88	108	84
1830, Jan. 5	α Tauri	257	248	256	28	β Scorpii	294	305	289
Mar. 28	θ¹ Tauri	290	280	288	May 20	95 Virginis	265	285	261
28	θ² Tauri	312	302	311	22	β Scorpii	123	135	119
28	264 B. Tauri	249	240	248	Aug. 29	48 Geminor.	84	90	89
28	85 Tauri	339	330	338	Sept. 20	38 Arietis	62	44	66
29	117 Tauri	312	308	312	Oct. 14	33 Piscium	289	266	290
Apr. 5	τ Leonis	270	293	276	1854, May 6	i Leonis	312	334	312
Oct. 5	θ¹ Tauri	263	253	262	Sept. 19	i Leonis	87	108	86
5	θ² Tauri	282	272	282	30	ω Sagittarii	262	252	260
5	85 Tauri	332	322	331	30	ω Sagittarii	98	88	96
1831, Jan. 26	f Geminor.	241	250	244	30	A Sagittarii	270	260	268
Feb. 19	48 Tauri	263	252	263	Oct. 11	139 Tauri	65	64	69
20	111 Tauri	312	308	314	Dec. 10	i Leonis	105	126	104
May 22	l Virginis	301	323	304	1855, Apr. 7	X Sagittarii	107	109	103
June 21	γ Libræ	247	233	247	23	λ Cancri	295	308	296
July 31	ξ² Ceti	107	88	105	Aug. 30	o Piscium	262	240	267
Oct. 21	ξ² Ceti	301	282	299	30	o Piscium	71	50	76
21	ξ² Ceti	51	32	50	Oct. 24	o Piscium	301	280	306
23	θ¹ Tauri	298	288	300	1856, Jan. 12	29 Piscium	198	174	202
23	θ² Tauri	329	319	330	Mar. 13	136 Tauri	272	270	274
23	75 Tauri	207	197	209	26	α Scorpii	289	299	286
23	θ¹ Tauri	48	38	50	Sept. 20	136 Tauri	332	330	334
23	75 Tauri	138	128	140	1857, Apr. 2	λ Cancri	252	265	250
23	99 Tauri	68	58	70	May 6	α Virginis	314	336	309
23	α Tauri	286	277	288	6	α Virginis	73	95	68
23	α Tauri	61	52	63	27	γ Cancri	340	354	337
Nov. 16	33 Ceti	224	201	221	Oct. 6	27 Tauri	219	206	222
24	π Cancri	8	24	13	6	27 Tauri	125	112	127
Dec. 18	119 Tauri	245	241	248	26	χ Capricor.	266	250	270
1847, Jan. 25	180 B. Tauri	232	221	229	28	70 Aquarii	300	278	305
Mar. 24	λ Geminor.	223	230	223	Nov. 27	ε Piscium	314	292	319
24	λ Geminor.	148	155	148	1858, Feb. 20	20 Tauri	291	277	293
26	κ Cancri	266	282	267	Apr. 25	28 Virginis	283	306	278
Apr. 22	A² Cancri	242	257	244	May 18	83 Cancri	203	220	199
May 23	υ Leonis	270	294	275	19	α Leonis	154	174	149
June 1	ρ Sagittarii	100	93	100	Aug. 30	q Tauri	273	259	274
1848, Jan. 16	α Tauri	45	36	43	30	q Tauri	69	55	70
May 7	68 Geminor.	321	330	323	30	20 Tauri	309	296	310
June 6	10 Sextantis	69	88	73	30	16 Tauri	37	24	38
July 11	θ Libræ	339	351	340	Nov. 22	136 Tauri	91	89	89
Aug. 21	γ Tauri	105	94	104	1859, Apr. 13	37 Sextantis	231	253	226
Sept. 15	ξ¹ Ceti	44	24	40	Sept. 21	μ Cancri	67	78	62
1849, Jan. 5	θ¹ Tauri	296	286	295	Dec. 8	23 Tauri	305	292	304
5	θ² Tauri	319	309	318	8	23 Tauri	46	33	45
5	264 B. Tauri	253	244	253	8	28 Tauri	310	297	309
5	θ¹ Tauri	75	65	74	8	27 Tauri	354	341	353
5	269 B. Tauri	264	254	263	8	17 Tauri	104	91	103
Feb. 27	85 Ceti	226	208	224	8	η Tauri	287	274	286
Mar. 29	111 Tauri	284	280	285	1860, Jan. 4	17 Tauri	325	312	324
29	111 Tauri	71	77	72	4	q Tauri	242	228	240
July 12	f Piscium	134	112	130	4	20 Tauri	256	243	255
Sept. 5	ν Piscium	217	196	214	Feb. 28	q Tauri	290	277	288
5	ν Piscium	140	118	137	28	16 Tauri	338	325	336
1850, Jan. 23	α Tauri	213	204	214	28	22 Tauri	281	268	280
23	α Tauri	152	143	153	28	20 Tauri	316	306	318
Mar. 23	o¹ Cancri	267	282	272	Mar. 4	δ Cancri	247	261	242
June 1	42 Aquarii	88	68	83	5	18 Leonis	263	282	258
Aug. 14	γ Libræ	260	274	259	Sept. 6	η Tauri	105	91	102
Dec. 17	75 Tauri	272	262	275	6	27 Tauri	66	52	63
1851, Jan. 15	64 Orionis	240	239	244	6	28 Tauri	83	70	81
15	68 Orionis	283	283	287	1861, Mar. 19	5 Geminor.	318	318	313
Mar. 13	d¹ Cancri	346	359	352	June 25	18 Aquarii	202	184	206
13	θ Cancri	276	273	282	Sept. 14	π Capricor.	285	272	289

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1861, Sept. 14	ρ Capricor.	238	225	242	1872, July 22	69 Aquarii	84	63	85
Oct. 20	ζ Arietis	281	265	278	Aug. 15	σ Sagittarii	126	122	122
22	103 Tauri	264	258	259	Sept. 15	69 Aquarii	282	263	285
1862, Mar. 9	6 Geminor.	295	295	289	15	τ Aquarii	249	228	250
Apr. 15	43 B. Libræ	85	101	88	24	ε Geminor.	274	277	278
July 15	κ Piscium	115	92	115	24	ε Geminor.	63	66	67
21	υ Tauri	121	112	118	Oct. 11	35 Capricor.	332	316	332
Sept. 3	π Sagittarii	185	179	190	14	33 Piscium	283	260	285
Oct. 11	κ Tauri	256	247	253	Dec. 9	f Piscium	212	190	216
11	κ Tauri	104	96	100	1873, May 1	39 Geminor.	276	280	279
Dec. 10	α Cancri	311	326	307	July 4	λ Virginis	318	337	312
10	α Cancri	73	88	69	Aug. 9	τ Aquarii	242	220	244
1863, Jan. 27	δ Arietis	251	236	247	Oct. 3	τ Aquarii	239	218	242
27	δ Arietis	104	89	100	13	λ Cancri	44	55	44
Mar. 2	α Cancri	300	316	297	Dec. 1	o Arietis	237	220	243
Apr. 26	κ Cancri	286	302	284	24	τ Aquarii	295	274	298
26	κ Cancri	93	109	90	24	τ Aquarii	41	20	45
July 28	36 Sagittarii	245	240	249	1874, Jan. 25	53 Arietis	233	218	239
Oct. 23	16 Piscium	211	188	208	27	k Tauri	271	265	276
30	χ^1 Orionis	277	275	273	30	c Geminor.	222	230	222
30	χ^1 Orionis	80	79	76	Mar. 26	λ Cancri	323	335	322
1864, Mar. 18	A^1 Cancri	231	245	230	31	10 Virginis	264	287	259
18	A^2 Cancri	279	293	277	May 19	c Geminor.	227	236	227
19	ω Leonis	269	286	268	July 8	53 Arietis	63	48	69
June 26	62 Piscium	306	284	302	Oct. 22	27 Piscium	244	221	249
26	62 Piscium	54	31	50	22	29 Piscium	246	223	251
26	δ Piscium	256	233	252	Nov. 19	10 Ceti	312	289	317
26	δ Piscium	104	81	100	Dec. 19	π Arietis	283	267	289
Dec. 5	κ Aquarii	232	211	230	1875, May 12	37 Leonis	335	355	331
1865, Mar. 3	68 Tauri	317	308	314	Oct. 16	ζ Arietis	232	217	236
July 3	α Libræ	314	331	318	16	ζ Arietis	101	87	107
3	α Libræ	38	55	43	Nov. 21	β Virginis	274	296	268
Nov. 4	64 Tauri	141	131	138	21	β Virginis	103	126	98
Dec. 30	115 Tauri	314	310	312	1876, Feb. 2	27 Arietis	291	273	296
1866, Sept. 28	75 Tauri	102	93	100	Apr. 7	f Virginis	296	319	290
28	α Tauri	67	58	65	11	b Scorpii	41	53	37
Nov. 16	67 Aquarii	305	284	301	May 5	50 Virginis	297	319	292
20	ξ Arietis	249	230	245	Nov. 29	47 Arietis	292	276	296
27	o Leonis	281	299	285	1877, Jan. 30	45 Leonis	55	76	50
27	o Leonis	67	85	70	30	ρ Leonis	272	293	266
1867, June 14	49 Libræ	236	248	238	30	ρ Leonis	110	131	104
Nov. 8	10 Ceti	270	247	266	Feb. 26	α Leonis	279	299	274
1868, Feb. 28	μ Ceti	342	324	340	Nov. 20	q Tauri	231	218	231
Mar. 1	θ^2 Tauri	276	266	276	20	q Tauri	111	98	111
1	θ^1 Tauri	255	245	255	20	20 Tauri	264	250	264
May 4	l Virginis	268	290	271	20	20 Tauri	79	66	79
27	18 Leonis	283	301	287	20	17 Tauri	41	28	42
1869, Jan. 24	120 Tauri	246	242	249	1878, Mar. 16	A Leonis	340	360	334
24	119 Tauri	221	217	223	June 5	π Cancri	301	317	294
Aug. 2	α Tauri	70	61	73	Sept. 6	51 Sagittarii	288	280	294
Dec. 14	ξ^2 Ceti	310	291	311	Nov. 10	17 Tauri	263	250	262
1870, Feb. 10	m Tauri	324	318	328	10	17 Tauri	82	69	82
May 14	30 Libræ	324	338	320	10	20 Tauri	221	208	220
Aug. 17	μ Ceti	107	90	110	10	η Tauri	316	304	315
19	64 Tauri	123	113	127	1879, Apr. 30	83 B. Leonis	338	357	333
Sept. 16	i Tauri	86	79	91	May 3	q Virginis	222	245	219
Oct. 1	117 B. Sagittarii	307	304	302	July 28	α Scorpii	198	207	201
14	ζ Tauri	263	260	268	28	α Scorpii	150	159	153
14	ζ Tauri	88	84	92	Aug. 25	142 B. Ophiuchi	248	253	252
1871, Mar. 3	η Cancri	295	308	298	Sept. 26	λ Capricor.	262	243	266
3	39 Cancri	274	287	277	Oct. 4	36 Tauri	98	87	96
Oct. 23	69 Aquarii	327	306	327	Nov. 18	σ Capricor.	274	262	280
23	τ Aquarii	274	253	274	22	16 Piscium	233	210	235
Dec. 20	ν Piscium	210	188	213	Dec. 22	101 Piscium	319	297	318
1872, Feb. 21	γ Cancri	249	262	250	1880, Jan. 20	ε Arietis	251	235	246
21	γ Cancri	124	137	125	Mar. 13	101 Piscium	298	277	297
May 19	65 Virginis	263	285	260	21	d^2 Cancri	245	258	240
19	66 Virginis	269	291	266	Apr. 16	56 Geminor.	326	334	322
22	ω^2 Scorpii	299	310	293	May 18	p^2 Leonis	277	299	274
22	ω^2 Scorpii	88	99	82	Sept. 13	50 Sagittarii	308	300	313

GREENWICH—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1880, Nov. 17	υ Tauri	293	282	288
19	η Geminor.	265	266	260
19	μ Geminor.	236	238	231
19	μ Geminor.	138	140	134
20	ζ Geminor.	284	290	280
20	ζ Geminor.	73	79	69
1881, Jan. 5	19 Piscium	331	308	332
12	394 B. Tauri	271	269	267
Mar. 8	14 B. Geminor.	278	278	272
16	q Virginis	234	257	235
16	q Virginis	139	162	140
May 4	5 Cancri	270	282	267
Sept. 3	33 Sagittarii	231	226	235
Oct. 5	κ Piscium	259	236	258
5	9 Piscium	293	270	292
9	54 Arietis	31	14	26
Nov. 12	α Cancri	263	278	260
12	α Cancri	105	120	102
29	16 Piscium	283	260	282
29	19 Piscium	272	249	270
Dec. 30	45 Arietis	264	247	260
1882, Apr. 1	e Leonis	357	20	358
Aug. 2	22 Piscium	111	88	109
Sept. 20	μ Sagittarii	290	289	294
Oct. 1	l Tauri	142	136	137
2	57 Orionis	79	78	75
22	κ Aquarii	330	310	330
24	51 Piscium	203	187	199
Nov. 26	64 Orionis	104	104	101
1883, Mar. 12	o Arietis	300	283	295
July 17	16 G. Sagittarii	239	240	242
Aug. 24	148 B. Tauri	97	85	93
Sept. 14	c^1 Capricor.	195	176	193
14	c^2 Capricor.	275	256	274
1884, Feb. 6	120 Tauri	89	86	86
Mar. 6	λ Geminor.	246	253	245
May 30	16 Sextantis	267	287	269
Dec. 30	115 Tauri	256	252	254
1885, Feb. 20	38 Arietis	202	184	198
23	130 Tauri	256	254	255
Mar. 22	111 Tauri	303	299	302
22	117 Tauri	348	344	346
27	B. A. C. 3529	309	330	313
27	43 Leonis	229	250	233
28	75 Leonis	280	303	285
Apr. 20	Pi. VII 39	321	328	322
20	λ Geminor.	207	214	208
20	λ Geminor.	161	168	162
July 22	29 Ophiuchi	338	344	338
Aug. 20	95 B. Sagittarii	225	223	224
Sept. 1	θ^2 Tauri	84	74	82
1	264 B. Tauri	141	131	139
1	85 Tauri	45	35	42
20	18 Aquarii	305	288	302
21	150 B. Aquarii	245	225	241
Oct. 1	λ Geminor.	284	290	286
Nov. 17	80 B. Piscium	242	219	238
Dec. 28	θ Virginis	112	134	116
1886, Jan. 14	85 Ceti	304	286	301
16	θ^2 Tauri	67	57	66
16	θ^1 Tauri	88	78	86
16	264 B. Tauri	239	229	238
16	α Tauri	232	224	232
16	α Tauri	123	114	121
18	26 Geminor.	284	287	285
Mar. 9	ξ^1 Ceti	259	240	256
9	64 Ceti	74	54	70
9	ξ^1 Ceti	107	88	105
Apr. 10	26 Geminor.	241	259	243
15	τ Leonis	333	356	338
1886, May 6	111 Tauri	291	287	292
June 23	24 Piscium	107	84	103
Aug. 19	ν Piscium	84	63	81
Sept. 7	190 B. Sagittarii	319	313	316
Oct. 22	44 Leonis	29	50	34
22	Pi. X 67.	32	53	37
Nov. 21	46 Virginis	131	153	134
Dec. 3	h Aquarii	256	234	251
3	84 Aquarii	272	250	268
18	γ Virginis	132	155	136
1887, Jan. 5	f Tauri	292	278	292
5	f Tauri	55	41	55
6	θ^2 Tauri	47	37	47
6	θ^1 Tauri	71	61	71
6	α Tauri	239	230	239
12	45 Leonis	129	150	134
12	ρ Leonis	242	264	247
12	ρ Leonis	111	132	116
28	4 Ceti	236	213	233
28	5 Ceti	222	199	218
Feb. 6	3 Cancri	248	259	253
Mar. 2	α Tauri	187	178	188
2	α Tauri	164	155	165
13	γ Libræ	105	119	105
Apr. 30	54 Cancri	309	324	313
30	o^1 Cancri	212	227	216
July 1	η Libræ	332	345	332
Aug. 8	29 Ceti	144	122	142
31	45 Capricor.	284	265	279
Sept. 28	42 Aquarii	321	301	317
Oct. 12	α Leonis	268	288	272
12	α Leonis	83	103	88
26	70 Aquarii	288	267	284
28	54 B. Ceti	316	293	314
Dec. 27	75 Tauri	277	267	279
1888, Oct. 20	μ Ceti	300	282	302
1889, Feb. 9	i Tauri	322	314	326
12	63 Geminor.	212	219	216
Sept. 16	ζ Tauri	307	304	312
Oct. 5	56 Aquarii	230	209	227
29	208 B. Sagittarii	265	258	259
Dec. 31	85 Ceti	223	205	227
1890, Jan. 15	o Libræ	74	89	70
Feb. 7	ν Virginis	275	298	275
7	ν Virginis	94	117	94
Apr. 7	32 Libræ	143	157	138
30	ν Virginis	232	255	232
30	ν Virginis	145	168	145
May 3	95 Virginis	353	13	350
3	κ Virginis	345	5	342
June 2	ω Ophiuchi	308	318	303
29	56 B. Scorpii	90	102	86
29	β Scorpii	90	102	86
Sept. 6	394 B. Tauri	112	110	118
20	24 Ophiuchi	237	244	232
27	33 Piscium	293	270	295
Oct. 27	ξ^1 Ceti	242	222	246
1891, Jan. 4	2 Libræ	63	82	58
Feb. 17	121 Tauri	230	226	235
Mar. 26	l Virginis	121	143	117
28	ν Libræ	130	146	125
Apr. 18	42 Leonis	290	312	291
20	ν Virginis	111	134	109
Aug. 14	26 Ophiuchi	314	320	309
Oct. 15	30 Piscium	318	295	321
1892, Feb. 1	376 B. Aquarii	235	212	238
7	118 Tauri (S.)	285	281	289
7	118 Tauri (N.)	285	281	289
Mar. 8	4 Cancri	211	222	213
Apr. 2	139 Tauri	304	303	307

GREENWICH—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1892, Aug. 11	14 Ceti	31	8	35	1896, Oct. 27	52 Geminor.	240	246	236
Sept. 12	κ Tauri	95	88	99	Dec. 17	η Tauri	330	316	329
15	4 Cancri	103	114	105	1897, May 4	332 B. Tauri	132	126	129
Oct. 3	τ Aquarii	291	269	294	June 18	151 B. Capricor.	327	308	332
Nov. 30	122 G. Piscium	329	307	334	18	151 B. Capricor.	12	353	17
30	122 G. Piscium	328	307	334	July 13	χ Sagittarii	234	226	239
Dec. 25	351 B. Aquarii	282	259	286	13	χ Sagittarii	117	109	121
1893, Feb. 26	c Geminor.	319	328	320	23	17 Tauri	250	238	249
Apr. 18	32 Tauri	307	295	312	23	16 Tauri	190	177	188
21	47 Geminor.	300	306	300	23	16 Tauri	163	150	161
22	λ Cancri	289	302	289	23	23 Tauri	314	301	313
May 6	b Sagittarii	47	36	47	23	17 Tauri	101	88	100
July 9	32 Tauri	80	68	85	23	Pi. III 135	154	142	153
30	56 Aquarii	77	56	81	23	η Tauri	292	279	291
Oct. 19	37 Capricor.	268	250	270	23	23 Tauri	36	23	35
19	38 Capricor.	307	289	310	23	24 Tauri	62	49	60
25	40 Arietis	213	196	218	23	η Tauri	57	44	55
30	4 Cancri	38	49	37	23	28 Tauri	320	306	318
Nov. 22	δ Arietis	330	314	335	23	Pi. III 151	98	85	97
1894, Jan. 12	24 Piscium	295	272	300	23	28 Tauri	28	15	27
20	c Geminor.	297	307	296	23	105 B. Tauri	94	81	92
Feb. 13	36 Tauri	321	309	324	23	Pi. III 164	316	303	314
Mar. 16	4 Cancri	257	268	256	Aug. 4	89 Virginis	307	328	306
23	40 H. Virginis	117	137	113	Oct. 3	48 Sagittarii	285	277	290
25	2 Scorpii	88	101	85	3	χ Sagittarii	307	299	312
25	3 Scorpii	127	139	123	3	χ Sagittarii	32	24	37
Apr. 9	χ Tauri	257	247	260	1898, Jan. 3	17 Tauri	240	227	238
10	107 B. Aurigæ	275	272	277	3	23 Tauri	302	289	299
11	49 Aurigæ	253	256	253	3	17 Tauri	112	99	110
16	σ Leonis	153	176	148	3	24 Tauri	277	264	274
May 12	37 Leonis	248	268	244	3	η Tauri	281	268	279
30	ζ Piscium	48	26	54	3	Pi. III 151	239	226	237
Nov. 15	136 Tauri	301	300	302	3	23 Tauri	53	40	51
15	136 Tauri	44	43	45	3	105 B. Tauri	238	225	236
1895, Feb. 6	49 Aurigæ	208	211	208	3	28 Tauri	294	282	292
Mar. 10	82 Leonis	236	259	231	3	27 Tauri	317	304	315
10	83 Leonis	252	275	247	3	η Tauri	79	66	76
10	Pi. XI 71	252	276	247	3	27 Tauri	49	36	46
10	τ Leonis	242	265	237	Mar. 13	α Scorpii	260	270	264
10	83 Leonis	134	157	128	13	α Scorpii	104	114	108
10	Pi. XI 71	133	156	128	Apr. 29	ξ Leonis	204	222	200
10	τ Leonis	142	165	136	May 2	13 B. Virginis	326	349	324
May 4	τ Leonis	277	300	272	June 5	λ Sagittarii	96	94	101
9	π Scorpii	136	148	134	Sept. 28	16 Piscium	252	229	254
11	γ^1 Sagittarii	328	328	328	Nov. 22	19 Piscium	228	205	230
June 26	α Leonis	307	327	302	Dec. 23	47 Arietis	303	286	300
26	α Leonis	74	94	69	23	47 Arietis	56	40	53
July 16	47 Arietis	58	40	60	1899, Jan. 19	μ Arietis	242	224	239
Aug. 6	42 Aquarii	54	34	60	Feb. 22	90 B. Cancri	300	314	296
7	81 Aquarii	64	42	70	Apr. 17	3 Cancri	351	2	346
7	82 Aquarii	212	190	217	May 26	9 Sagittarii	98	98	103
12	B. D.+18° 325	99	81	102	July 19	88 B. Ophiuchi	67	73	71
Sept. 2	ι Aquarii	286	266	291	19	26 Ophiuchi	89	95	93
15	83 Cancri	85	102	80	Dec. 16	175 H^1. Tauri	248	246	244
29	δ Capricor.	250	231	255	16	175 H^1. Tauri	129	127	124
29	δ Capricor.	80	61	85	1900, Jan. 9	27 Arietis	336	318	331
30	58 Aquarii	258	237	263	Feb. 6	δ Arietis	322	307	317
Nov. 3	19 Tauri	76	63	77	7	39 Tauri	230	219	225
3	20 Tauri	42	29	43	Apr. 4	o Tauri	256	251	250
Dec. 10	ψ Virginis	164	187	160	May 7	19 Sextantis	287	308	286
1896, Mar. 1	343 B. Virginis	61	84	58	June 2	κ Cancri	285	301	282
19	18 Tauri	256	243	256	July 11	ξ Sagittarii	296	291	300
27	79 Leonis	316	340	312	Sept. 4	36 Sagittarii	247	243	251
27	79 Leonis	72	95	67	4	36 Sagittarii	95	91	100
Apr. 26	83 Virginis	274	295	271	12	π Arietis	277	260	272
May 21	υ Leonis	282	305	277	13	13 Tauri	253	240	248
June 22	4 Scorpii	216	228	216	13	14 Tauri	277	263	272
24	38 B. Sagittarii	236	236	239	Oct. 3	27 G. Capricor.	257	244	260
July 20	τ Scorpii	59	68	61	1901, Mar. 26	68 Orionis	243	244	239
28	21 Piscium	33	10	37	Apr. 22	B. D.+19° 1110	247	245	242

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date	Star.	m	m_1	m′
		°	°	°			°	°	°
1901, Apr. 22	57 Orionis.	253	251	248	1904, Dec. 20	α Tauri	246	237	245
28	p^3 Leonis	255	277	257	1905, Jan. 10	φ Aquarii	248	225	242
May 31	11 H. Libræ	211	224	216	10	φ Aquarii	108	85	103
June 4	171 B. Sagittarii	137	131	140	17	318 B. Tauri	224	218	224
29	74 B. Ophiuchi	269	276	274	18	130 Tauri	284	282	286
July 28	21 Sagittarii	242	241	246	19	26 Geminor.	316	319	318
Aug. 24	24 B. Sagittarii	224	225	228	Mar. 12	48 Tauri	278	268	278
Oct. 23	κ Aquarii	263	241	261	16	2 B. Cancri	254	257	250
27	29 Arietis	229	211	224	19	56 Leonis	288	310	293
27	29 Arietis	133	115	128	Apr. 12	162 B. Geminor.	355	3	358
Dec. 18	λ Piscium	215	191	211	12	162 B. Geminor.	5	14	9
18	λ Piscium	141	117	137	15	44 Leonis	260	280	265
1902, Feb. 12	ϵ Piscium	326	303	321	15	44 Leonis	102	123	107
12	ϵ Piscium	33	20	28	17	η Virginis	306	329	311
13	26 B. Arietis	263	243	258	May 15	38 Virginis	347	10	351
15	163 B. Tauri	215	204	210	15	38 Virginis	17	40	21
16	ι Tauri	316	308	312	15	k Virginis	234	257	238
Mar. 17	26 Geminor.	313	316	310	Sept. 19	θ^1 Tauri	78	69	79
20	ω Leo. (1st)	268	285	269	Oct. 4	B. F. 2471	251	250	248
20	ω Leo. (2d)	268	285	269	Nov. 7	27 Piscium	239	215	234
May 12	12 Cancri	349	1	349	7	27 Piscium	116	92	111
June 18	Pi. XVI 3	285	296	290	7	29 Piscium	196	172	191
18	ν Scorpii	287	298	292	7	29 Piscium	159	135	154
Oct. 16	ζ Piscium	302	280	297	Dec. 9	f Tauri	295	281	295
Dec. 4	β Capricor.	231	218	230	1906, Jan. 4	ξ^2 Ceti	303	284	301
1903, May 2	68 Geminor.	258	266	258	10	y Geminor.	198	208	203
June 2	4 Leonis	298	317	299	Feb. 3	α Tauri	228	219	230
Sept. 3	27 G. Capricor.	274	261	271	3	α Tauri	117	108	118
Oct. 30	ρ Aquarii	204	183	199	4	115 Tauri	288	284	290
30	ρ Aquarii	152	130	147	4	115 Tauri	55	51	58
Nov. 4	ξ Arietis	315	296	311	7	ζ Cancri	252	240	256
9	λ Geminor.	114	121	115	Mar. 2	θ^2 Tauri	333	324	335
Dec. 2	W. B. II 1033	331	315	327	29	179 B. Tauri	306	295	307
4	318 B. Tauri	298	291	296	Apr. 3	d^2 Cancri	289	302	294
4	318 B. Tauri	56	49	54	4	π Cancri	281	298	287
10	d Leonis	325	348	331	5	α Leonis	127	147	132
10	d Leonis	27	50	32	6	χ Leonis	307	329	311
31	75 Tauri	322	312	320	27	119 Tauri	266	263	269
31	75 Tauri	33	24	31	27	120 Tauri	282	279	285
1904, Mar. 22	θ^1 Tauri	321	311	319	Sept. 9	α Tauri	338	329	340
22	75 Tauri	221	211	219	9	α Tauri	3	355	6
Apr. 24	10 Sextantis	279	298	283	Nov. 5	ν Geminor.	95	97	99
July 9	θ^1 Tauri	87	77	86	19	o Sagittarii	283	277	278
9	θ^2 Tauri	66	56	65	Dec. 5	χ Cancri	37	52	42
9	264 B. Tauri	239	229	238	1907, Jan. 26	ν Geminor.	290	292	295
9	α Tauri	229	220	228	Feb. 23	ζ Geminor.	243	249	248
9	α Tauri	123	114	122	Mar. 20	m Tauri	309	303	313
Aug. 30	ξ^1 Ceti	92	73	88	21	χ^1 Orionis	244	242	248
Sept. 29	γ Tauri	124	114	123	21	57 Orionis	278	278	282
29	71 Tauri	24	14	23	28	b Virginis	315	338	318
29	θ^1 Tauri	270	260	269	Apr. 19	56 Geminor.	323	330	328
29	θ^2 Tauri	292	282	291	May 24	n Virginis	338	359	338
29	θ^2 Tauri	61	51	60	June 24	ξ Ophiuchi	261	265	257
29	θ^1 Tauri	83	73	82	Sept. 24	μ Ceti	303	286	305
29	264 B. Tauri	244	234	243	24	μ Ceti	36	19	38
Nov. 20	64 Ceti	296	277	293	26	64 Tauri	234	224	237
20	ξ^1 Ceti	273	254	270	Oct. 2	8 Leonis	98	117	103
Dec. 20	γ Tauri	280	270	279	24	i Tauri	71	63	75
20	γ Tauri	69	59	68	Dec. 11	290 B. Aquarii	279	256	276
20	70 Tauri	293	283	292	17	δ Tauri	337	327	341
20	75 Tauri	232	222	231	17	68 Tauri	265	256	270
20	B. D.+15° 633	283	273	282	1908, Mar. 13	39 Cancri	280	295	285
20	θ^1 Tauri	334	324	333	13	40 Cancri	288	302	293
20	θ^1 Tauri	25	15	24	23	116 B. Ophiuchi	133	139	128
20	264 B. Tauri	288	279	287					

HAMBURG.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1882, Nov. 26	64 Orionis	255	255	251	1892, July 19	72 Tauri	227	217	232
26	64 Orionis	109	109	105	19	υ Tauri	93	83	98
1883, Jan. 4	κ Libræ	223	236	228	19	72 Tauri	116	106	121
11	117 G. Capricor.	307	288	306	Oct. 3	τ Aquarii	294	272	297
11	c^1 Capricor.	324	305	323	1893, July 6	e Piscium	131	110	136
13	15 Piscium	258	235	255	1894, Jan. 12	24 Piscium	300	277	305
1885, Nov. 22	α Tauri	264	255	263	Apr. 9	χ Tauri	242	232	245
1886, Jan. 16	α Tauri	232	223	231	9	χ Tauri (comp.)	242	232	245
16	α Tauri	126	117	125	11	49 Aurigæ	234	237	234
1891, Mar. 26	l Virginis	245	266	241	1895, June 26	α Leonis	297	317	292
Apr. 25	κ Libræ	87	100	82	26	α Leonis	81	101	76
Nov. 10	τ Aquarii	193	171	194	July 17	η Tauri	88	75	90
1892, Jan. 19	γ Virginis	305	328	301	Sept. 29	δ Capricor.	260	241	265
Mar. 16	λ Virginis	128	147	123	29	δ Capricor.	70	51	75
June 6	λ Virginis	225	244	220	1896, Apr. 19	A Geminor.	239	247	235
8	δ Scorpii	213	225	208					

HABANA.

1808, Apr. 5	60 Cancri	250	265	248	1811, July 15	α Tauri	313	304	312
May 3	ω Leonis	205	222	205	26	θ Virginis	273	295	278
1809, Apr. 29	8 Libræ	247	264	252	Oct. 23	45 Sagittarii	305	298	303
29	α Libræ	252	269	258	1812, May 24	ν Libræ	243	257	244
29	α Libræ	114	131	119	Aug. 28	α Tauri	230	221	231
June 23	8 Libræ	272	289	277	28	α Tauri	110	101	111
23	α Libræ	277	294	282	Oct. 19	ν Piscium	253	232	251
28	β Capricor.	264	252	264	Nov. 24	α Leonis	188	207	193
28	β Capricor.	75	63	75	24	α Leonis	152	171	157
Nov. 12	β Capricor.	269	257	268	Dec. 10	85 Aquarii	248	226	243
12	β Capricor.	73	61	72	10	87 Aquarii	235	213	230
1810, Feb. 18	π Leonis	259	278	263					

JENA.

1905, Aug. 17	27 Piscium	271	248	267	1906, Apr. 5	α Leonis	130	150	135
23	89 Tauri	75	67	76	6	χ Leonis	302	324	306
23	σ^2 Tauri	25	16	26	11	49 Libræ	57	69	56
Sept. 17	μ Ceti	250	232	249	June 7	μ Sagittarii	289	288	286
17	μ Ceti	100	82	98	7	μ Sagittarii	83	82	80
18	f Tauri	83	69	82	July 2	γ Libræ	226	240	226
19	γ Tauri	215	205	215	1907, Jan. 26	ν Geminor.	302	305	307
19	γ Tauri	133	123	134	Mar. 21	χ^1 Orionis	243	242	247
1906, Jan. 4	ξ^2 Ceti	320	301	319	June 21	652 B. Virginis	213	233	213
Apr. 4	π Cancri	278	295	283					

KASAN.

1890, Nov. 21	33 Piscium	227	203	229	1897, Dec. 6	ε Arietis	266	250	265
Dec. 20	ν Piscium	293	272	293	7	27 Tauri	214	201	211
1891, Apr. 15	κ Geminor.	274	284	278	1898, Jan. 2	ε Arietis	341	325	339
15	κ Geminor.	92	102	95	Mar. 1	125 Tauri	197	194	194
June 12	i Leonis	220	241	220	26	9 Tauri	284	270	281
Nov. 10	69 Aquarii	282	260	283	Apr. 1	54 Cancri	312	327	307
10	τ Aquarii	244	222	245	4	p^5 Leonis	252	275	249
1894, Mar. 16	c Geminor.	341	351	340	July 30	λ Sagittarii	271	269	276
May 14	β Virginis	230	253	225	Nov. 22	19 Piscium	266	243	267
Dec. 8	π Piscium	269	248	273	22	19 Piscium	86	63	87
1895, Feb. 8	γ Cancri	295	309	291	Dec. 19	κ Piscium	266	243	268
1896, Apr. 22	ν Leonis	243	262	238	23	47 Arietis	287	271	284
Oct. 16	e Aquarii	263	243	268	1899, Feb. 18	103 Tauri	221	215	216
1897, Apr. 12	19 Leonis	232	251	227	19	1 Geminor.	307	307	302
Dec. 2	22 Piscium	321	298	324	Mar. 20	56 Geminor.	249	257	244

KASAN—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1899, Apr. 19	*h* Leonis	265	283	261	1905, Jan. 18	130 Tauri	298	297	300
July 20	7 Sagittarii	242	242	247	Feb. 13	70 Tauri	227	217	226
Oct. 12	57 Sagittarii	278	268	281	13	71 Tauri	311	302	311
1904, Jan. 4	29 Cancri	242	255	245	Mar. 10	389 B. Ceti	252	234	250
4	29 Cancri	108	121	111	Apr. 12	162 B. Geminor.	286	295	290
Feb. 24	θ^1 Tauri	21	11	18	May 13	56 Leonis	337	359	342
29	o Leonis	262	280	266	13	c Leonis	244	267	249
29	o Leonis	101	119	105	14	β Virginis	322	345	326
Mar. 22	γ Tauri	334	324	332	1906, May 1	o^2 Cancri	340	355	345
22	γ Tauri	36	26	34	June 8	π Sagittarii	95	89	91
27	209 B. Cancri	339	355	342	July 5	115 B. Sagittarii	329	326	325
Apr. 24	83 B. Leonis	238	257	241	5	121 B. Sagittarii	246	243	242
May 21	o Leonis	292	310	295	Oct. 25	114 B. Capricor.	234	217	230
Nov. 23	α Tauri	144	134	142	25	ι Capricor.	246	229	241
Dec. 20	θ^1 Tauri	303	293	302	Dec. 25	ξ^2 Ceti	230	211	230
20	θ^2 Tauri	332	322	331	1907, July 23	ν^1 Sagittarii	278	273	273
20	48 Tauri	309	298	308	23	ν^2 Sagittarii	265	260	260
20	γ Tauri	310	300	310	Aug. 18	ξ Ophiuchi	249	253	245

KIEL.

1876, Oct. 6	17 Tauri	239	226	242	1876, Oct. 6	20 Tauri	149	136	151
6	17 Tauri	101	88	104	6	24 Tauri	285	272	288
6	16 Tauri	178	165	181	6	24 Tauri	56	43	58
6	16 Tauri	162	149	165	6	η Tauri	291	278	293
6	23 Tauri	303	290	305	6	η Tauri	50	37	53

KÖNIGSBERG.

1905, Sept. 9	B. D. −18° 5646	258	245	253	1906, Apr. 2	B. D. +18° 1652	280	288	285
18	*f* Tauri	268	254	268	2	B. D. +18° 1653	308	316	312
18	B. D. +12° 485	33	19	33	4	π Cancri	262	280	267
18	*f* Tauri	37	23	37	5	α Leonis	203	224	208
Oct. 4	B. D. −19° 4858	258	258	256	5	α Leonis	158	179	163
4	B. D. −20° 5003	308	308	305	6	χ Leonis	284	306	288
4	B. D. −19° 4863	260	260	257	6	B. D. + 7° 2412	300	323	305
4	B. D. −20° 5011	295	295	293	July 2	8 Libræ	206	221	206
4	39 G. Sagittarii	255	255	253	Sept. 9	75 Tauri	242	232	244
1906, Jan. 1	B. D. − 3° 14	288	264	284	Oct. 11	θ Cancri	211	225	216
Feb. 8	π Cancri	215	232	220	11	θ Cancri	132	146	138
Mar. 29	α Tauri	116	108	118	26	B. D. −14° 6228	328	307	323
Apr. 2	B. D. +18° 1616	339	347	343	26	39 Aquarii	322	302	318
2	Berlin A. 2834	337	345	341	26	B. D. −14° 6223	261	240	256
2	B. D. +18° 1618	339	347	343	1907, Jan. 20	B. D. + 3° 219	279	257	278
2	B. D. +18° 1640	270	278	275	Feb. 25	δ Cancri	235	250	240
2	B. D. +18° 1641	272	280	277					

KREMSMUNSTER.

1869, May 18	α Leonis	333	353	337	1869, May 18	α Leonis	28	48	32

LEIDEN.

1857, Sept. 29	128 B. Capricor.	217	199	221	1859, May 7	82 Geminor.	283	265	279
Dec. 26	B.D. +18° 325	213	194	216	Nov. 11	χ Tauri	299	289	298
1858, May 20	56 Leonis	326	349	321	1860, Jan. 6	112 B. Aurigæ	258	254	254
Sept. 21	82 Aquarii	218	195	223	Mar. 1	112 B. Aurigæ	249	246	246
Oct. 21	210 B. Piscium	292	269	296	1	112 B. Aurigæ	116	113	113
Dec. 22	40 Cancri	30	45	26	4	δ Cancri	242	257	237
22	39 Cancri	42	56	37	4	δ Cancri	133	148	128
1859, Apr. 11	176 B. Cancri	269	284	264	June 1	50 G. Libræ	312	328	313
May 5	112 B. Aurigæ	325	322	322	Nov. 5	o^1 Cancri	301	316	296
5	112 B. Aurigæ	54	51	52	5	o^1 Cancri	69	84	64

LEIDEN—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1860, Nov. 5	o^2 Cancri	239	254	234
5	o^2 Cancri	128	144	123
Dec. 19	16 Piscium	229	206	231
1861, Apr. 19	*o* Leonis	251	270	247
27	151 G. Ophiuchi	102	106	107
May 19	13 B. Virginis	273	297	272
June 11	ζ Cancri	271	283	266
11	ζ Cancri	106	118	101
Sept. 26	9 Geminor.	140	141	135
26	11 Geminor.	78	79	73
Oct 15	22 B. Piscium	297	274	299
15	9 Piscium	254	231	255
15	9 Piscium	87	64	88
15	κ Piscium	213	190	214
15	κ Piscium	127	104	129
19	B. D.+18°325	52	33	49
20	ζ Arietis	70	54	66
Dec. 23	*e* Leonis	273	296	272
1862, Mar. 15	*e* Leonis	276	299	275
15	*e* Leonis	102	125	101
Apr. 15	43 B. Libræ	273	290	277
1863, Jan. 9	55 Leonis	92	114	91
27	δ Arietis	104	88	100
Mar. 2	α Cancri	293	309	291
2	α Cancri	87	103	84
24	51 Tauri	199	188	194
24	53 Tauri	48	37	42
Apr. 2	13 B. Virginis	326	349	327
Aug. 7	ω Tauri	293	282	288
Oct. 23	16 Piscium	216	193	214
30	χ^1 Orionis	79	78	75
Nov. 19	κ Piscium	255	232	253
19	9 Piscium	289	266	287
30	60 Cancri	259	274	258
30	60 Cancri	100	116	99
Dec. 24	χ^2 Orionis	89	88	84
27	A^1 Cancri	263	278	262
27	A^1 Cancri	108	123	106
27	A^2 Cancri	306	321	305
27	A^2 Cancri	72	87	71
30	p^3 Leonis	90	112	91
1864, Jan. 24	κ Cancri	310	326	309
24	κ Cancri	46	63	46
Mar. 18	A^2 Cancri	272	287	271
18	A^2 Cancri	105	120	104
19	ω Leonis	266	283	265
19	ω Leonis	102	120	102
Apr. 20	49 Virginis	241	264	245
20	49 Virginis	125	148	129
23	λ Libræ	250	263	255
Nov. 10	62 Piscium	258	235	253
10	62 Piscium	108	85	103
19	κ Cancri	228	244	228
19	κ Cancri	128	144	128
1865, Jan. 8	302 B. Tauri	315	307	311
8	*i* Tauri	330	323	326
Feb. 9	κ Cancri	275	291	276
Apr. 30	67 Geminor.	260	269	260
July 3	8 Libræ	301	319	306
3	α Libræ	311	329	316
8	ρ^1 Sagittarii	221	214	222
1865, Aug. 6	8 Aquarii	304	289	303
Oct. 4	147 B. Piscium	264	242	260
Nov. 5	115 Tauri	292	288	289
5	115 Tauri	64	60	62
1866, Sept. 28	99 Tauri	304	304	301
28	α Tauri	292	284	290
29	111 Tauri	240	236	239
29	111 Tauri	114	109	112
29	117 Tauri	294	290	293
29	117 Tauri	59	55	58
1867, Oct. 16	85 Tauri	75	65	74
1868, Feb. 8	*A* Leonis	50	70	55
11	*k* Virginis	321	343	325
11	*k* Virginis	46	68	49
28	μ Ceti	335	317	332
28	μ Ceti	35	17	33
Mar. 1	71 Tauri	306	296	306
1	70 Tauri	130	120	130
1	θ^2 Tauri	275	265	274
1	θ^1 Tauri	254	244	254
1	θ^1 Tauri	105	95	105
1	θ^2 Tauri	85	75	85
1	264 B. Tauri	213	203	212
1	85 Tauri	306	296	306
28	γ Tauri	259	248	259
May 4	*l* Virginis	262	284	265
27	18 Leonis	279	298	284
Sept. 4	33 Ceti	282	260	279
6	μ Ceti	227	209	225
8	71 Tauri	278	268	279
8	71 Tauri	71	61	71
8	θ^2 Tauri	256	246	257
8	264 B. Tauri	208	198	208
8	264 B. Tauri	139	129	139
8	85 Tauri	36	26	36
8	α Tauri	215	205	215
8	α Tauri	138	128	138
9	115 Tauri	122	118	124
1869, Jan. 23	θ^2 Tauri	311	301	313
23	θ^2 Tauri	35	25	36
23	θ^1 Tauri	60	50	61
23	264 B. Tauri	267	257	268
24	120 Tauri	246	242	249
24	119 Tauri	221	217	224
24	119 Tauri	129	125	131
1870, Feb. 9	63 Tauri	262	252	265
10	*m* Tauri	320	314	324
11	χ^2 Orionis	337	337	342
11	χ^2 Orionis	21	21	25
July 10	158 G. Ophiuchi	258	261	253
Aug. 17	μ Ceti	244	226	246
1871, Jan. 11	ν Virginis	262	285	263
11	ν Virginis	94	117	96
Oct. 23	69 Aquarii	342	320	340
23	69 Aquarii	10	348	8
23	τ Aquarii	280	258	279
23	τ Aquarii	66	44	65
1872, May 19	65 Virginis	255	277	252
19	66 Virginis	263	285	260
22	ω^1 Scorpii	265	277	260
22	ω^2 Scorpii	291	303	287

LEIPZIG.

Date	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1869, May 18	α Leonis	326	346	331	1876, Oct. 6	23 Tauri	312	299	314
1870, June 16	η Capricor.	303	287	298	6	20 Tauri	204	191	206
1871, Nov. 18	ε Capricor.	233	215	231	6	η Tauri	299	286	301
1872, Aug. 15	σ Sagittarii	243	238	238	6	Anon. 24	259	246	261
15	σ Sagittarii	124	119	120	6	Anon. 29	268	255	270
1875, Jan. 30	31 B. Scorpii	308	321	304	6	Anon. 32	277	264	279
Feb. 13	36 Tauri	233	221	237	6	16 Tauri	141	128	143
13	36 Tauri	137	125	140	6	17 Tauri	94	81	96
Mar. 16	ω Cancri	270	281	269	6	23 Tauri	29	16	31
16	4 Cancri	323	334	322	6	20 Tauri	134	121	136
Nov. 16	47 Geminor.	302	308	302	6	η Tauri	41	28	43
1876, Feb. 2	27 Arietis	304	285	308	6	Anon. 24	79	66	81
Apr. 1	47 Geminor.	326	332	324	Nov. 30	η Tauri	231	218	233
June 29	i Virginis	261	283	257	30	27 Tauri	270	257	272
Oct. 6	17 Tauri	245	232	247	30	28 Tauri	253	240	255
6	16 Tauri	197	184	199	30	27 Tauri	75	62	77

NEAR LEIPZIG.

1876, Feb. 2	27 Arietis	304	285	308	1876, Nov. 30.	28 Tauri	253	240	255
Mar 6	γ Cancri	316	330	313	1879, Dec. 27	132 Tauri	295	293	290
Oct. 6	16 Tauri	197	184	199	1880, Jan. 28	π Leonis	240	259	236
6	16 Tauri	141	128	143	28	π Leonis	146	165	142
6	17 Tauri	245	232	247	Feb. 18	62 Tauri	307	297	303
6	20 Tauri	204	191	206	Mar. 13	101 Piscium	292	270	291
6	23 Tauri	312	299	314	18	132 Tauri	239	237	234
6	η Tauri	299	286	301	25	13 B. Virginis	300	323	299
6	24 Tauri	293	280	295	July 17	31 B. Scorpii	272	285	276
Nov. 30	η Tauri	231	218	233	Aug. 28	121 Tauri	250	247	245
30	26 Tauri	311	298	313	Sept. 25	1 Geminor.	250	250	245
30	27 Tauri	270	257	272	25	1 Geminor.	107	107	102

MADRID.

1869, Nov. 17	μ Ceti	285	267	286	1869, Nov. 17	μ Ceti	52	34	53

NEUCHATEL.

1872, Aug. 15	σ Sagittarii	248	243	243					

NIKOLAIEFF.

1873, Apr. 30	139 Tauri	243	242	247	1873, Aug. 9	τ Aquarii	269	247	271
May 1	39 Geminor.	248	253	252	9	τ Aquarii	154	132	155
1	40 Geminor.	280	285	284	10	376 B. Aquarii	102	79	106
5	42 Leonis	299	320	298	11	15 Ceti	84	61	88
11	8 Libræ	297	314	291	12	μ Piscium	111	89	115
11	α Libræ	300	317	294	18	39 Geminor.	78	83	81
11	α Libræ	91	108	85	18	40 Geminor.	34	39	37
16	ω Sagittarii	116	106	114	Oct. 3	τ Aquarii	283	261	285
June 5	46 Virginis	231	253	226	9	υ Tauri	10	0	15
July 1	b Virginis	309	332	306	9	72 Tauri	37	27	42
2	γ Virginis	90	113	87	1883, July 15	β Scorpii	293	305	298
19	κ Tauri	118	108	123	15	β Scorpii	54	66	59
19	67 Tauri	96	86	101					

PADUA.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1891, Nov. 10	τ Aquarii	224	202	226	1894, Nov. 20	χ Leonis	161	183	156
10	τ Aquarii	113	91	115	Dec. 10	66 Arietis	289	275	292
1894, Jan. 16	ζ Arietis	230	215	234	11	χ Tauri	314	304	316
16	τ Arietis	301	286	305	11	χ Tauri	26	16	28
July 17	A Sagittarii	247	236	249	1895, Mar. 29	ε Arietis	229	213	232
Aug. 23	27 Tauri	234	221	237	29	ε Arietis	135	119	138
23	28 Tauri	119	106	122	May 1	γ Cancri	270	284	266
23	27 Tauri	101	88	104	1	γ Cancri	118	132	114
Sept. 11	χ Capricor.	191	175	194	July 9	δ Capricor.	255	236	260
11	χ Capricor.	140	124	144	9	δ Capricor.	71	52	76
Oct. 7	A Sagittarii	219	209	221	Sept. 6	62 Piscium	225	202	229
7	A Sagittarii	115	105	117	6	62 Piscium	115	92	120
10	50 Aquarii	251	230	256	Dec. 28	20 Tauri	308	295	309
Nov. 7	70 Aquarii	258	236	263	1896, Jan. 19	14 Piscium	224	201	229

PARIS.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1810, Jan. 15	δ Tauri	249	239	245	1821, July 23	20 Tauri	93	81	94
15	64 Tauri	274	264	270	Sept. 10	σ Aquarii	296	275	302
May 10	60 Cancri	303	318	306	Oct. 13	16 Tauri	273	261	274
June 15	χ Ophiuchi	237	247	240	13	17 Tauri	306	294	307
July 25	63 Tauri	228	218	225	13	q Tauri	239	227	240
25	63 Tauri	127	117	125	13	20 Tauri	269	257	270
Sept. 18	α Tauri	290	281	287	13	21 Tauri	234	222	235
18	α Tauri	66	57	63	13	17 Tauri	37	25	37
1811, Jan. 19	θ Libræ	39	54	42	13	16 Tauri	76	64	76
Mar. 1	275 B. Tauri	306	297	304	13	q Tauri	103	91	104
1	α Tauri	276	267	274	13	Anon. 4	70	58	71
1	α Tauri	92	84	90	13	20 Tauri	73	61	74
7	o Leonis	317	335	322	13	21 Tauri	108	96	109
Aug. 26	49 Libræ	298	310	300	13	22 Tauri	103	91	104
Sept. 2	λ Aquarii	329	307	324	1822, Feb. 8	υ Leonis	359	22	353
2	λ Aquarii	34	12	29	8	υ Leonis	17	40	13
2	78 Aquarii	284	262	278	Apr. 30	d Leonis	253	275	248
2	78 Aquarii	76	54	71	Dec. 25	η Tauri	291	279	290
Oct. 23	187 B. Sagittarii	262	257	260	1823, June 17	69 Virginis	330	351	329
1812, Jan. 23	α Tauri	197	188	197	1824, Mar. 12	o Leonis	283	301	279
23	α Tauri	153	144	153	Dec. 7	μ Geminor.	109	110	104
Oct. 19	ν Piscium	273	252	270	31	ζ Arietis	311	296	307
21	f Tauri	52	38	51	1825, Feb. 11	θ Ophiuchi	63	67	58
1813, Mar. 6	μ Ceti	258	240	257	Mar. 28	g Geminor.	222	231	217
July 12	π Sagittarii	292	286	287	June 27	19 Scorpii	332	342	337
Dec. 28	ψ¹ Aquarii	242	220	238	July 4	κ Aquarii	309	288	310
1814, Oct. 1	μ Ceti	292	274	294	4	κ Aquarii	33	12	35
1	μ Ceti	49	31	51	Sept. 4	67 Tauri	247	238	242
1817, Dec. 30	γ Virginis	267	290	263	4	67 Tauri	108	99	103
1818, Feb. 13	A Tauri	260	249	265	4	κ Tauri	222	213	217
13	39 Tauri	290	279	295	1826, Sept. 13	c¹ Capricor.	294	276	294
1821, Feb. 6	62 Piscium	277	254	282	Oct. 24	κ Cancri	102	118	101
6	δ Piscium	238	215	243	1827, Jan. 5	π Piscium	294	273	290
12	49 Aurigæ	293	295	291	Feb. 10	60 Cancri	262	277	261
July 23	q Tauri	219	207	220	July 2	49 Virginis	306	328	311
23	20 Tauri	253	241	254	1829, June 13	μ Libræ	307	324	311
23	22 Tauri	221	209	222	13	μ Libræ	50	67	54
23	21 Tauri	210	199	210	Aug. 21	70 Tauri	51	41	49
23	21 Tauri	136	124	137	21	α Tauri	293	284	291
23	16 Tauri	94	82	95	Oct. 15	α Tauri	226	217	225
23	Anon. 4	90	78	90	15	α Tauri	127	118	125

POLA.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1886, Apr. 8	α Tauri	244	235	243	1894, Apr. 11	49 Aurigæ	251	254	251
8	α Tauri	124	115	123	1895, June 26	α Leonis	301	321	296
Aug. 8	24 Scorpii	262	271	262	Nov. 10	ρ Leonis	276	297	271
1887, Jan. 30	ν Piscium	258	237	255	10	ρ Leonis	110	131	105
Mar. 2	α Tauri	235	226	236	27	δ Piscium	263	240	267
2	α Tauri	120	111	121	1896, July 20	τ Scorpii	303	312	304
8	ρ Leonis	262	283	267	1898, Mar. 13	α Scorpii	256	266	260
July 16	α Tauri	227	218	229	1899, Apr. 28	θ Ophiuchi	264	268	269
1888, Aug. 20	γ Capricor.	296	278	291	28	θ Ophiuchi	92	96	97
Sept. 16	30 Capricor.	277	260	272	1901, Jan. 30	ζ Tauri	196	193	191
Oct. 13	20 Capricor.	245	229	240	30	ζ Tauri	169	166	164
1893, Dec. 13	χ Capricor.	243	224	246	Feb. 21	51 Piscium	300	277	296
1894, Jan. 16	ζ Arietis	232	217	236	July 25	κ Libræ	184	197	189
Mar. 22	α Virginis	281	303	276	Oct. 29	ε Tauri	205	195	200
Apr. 9	χ Tauri	264	254	267					

PRAGUE.

1883, Oct. 18	68 Tauri	325	315	321	1885, Sept. 1	α Tauri	218	209	216
23	κ Cancri	249	265	250	1	α Tauri	134	125	132
23	κ Cancri	110	126	111	Dec. 2	κ Virginis	193	212	197
Dec. 15	λ Geminor.	64	71	63	2	κ Virginis	173	192	177
1884, Feb. 6	119 Tauri	269	266	266	1886, Feb. 12	γ Tauri	278	268	277
6	119 Tauri	102	99	99	Aug. 8	24 Scorpii	255	263	255
6	120 Tauri	277	274	274	Dec. 3	h Aquarii	271	249	266
6	120 Tauri	96	93	93	1887, Mar. 2	α Tauri	213	204	214
16	λ Virginis	232	251	237	2	α Tauri	143	134	144
16	λ Virginis	132	151	137	8	ρ Leonis	245	266	250
17	ν Libræ	55	71	60	May 4	γ Virginis	213	236	216
Mar. 6	λ Geminor.	236	243	235	1892, Jan. 19	γ Virginis	304	327	301
May 8	λ Virginis	230	249	225	Oct. 3	τ Aquarii	300	278	303
July 3	32 Libræ	201	215	205	1894, Oct. 7	A Sagittarii	217	206	219
Oct. 9	130 Tauri	264	262	262	1895, Sept. 29	δ Capricor.	271	252	276
9	130 Tauri	89	87	87	29	δ Capricor.	57	38	62
Nov. 25	θ Aquarii	261	240	257	1898, Mar. 13	α Scorpii	249	259	253
1885, Jan. 22	e Piscium	293	272	288	13	α Scorpii	110	120	114
Mar. 22	111 Tauri	302	298	300					
Apr. 24	d Leonis	217	239	222					

RADCLIFFE.

1862, June 9	43 B. Libræ	266	283	270	1869, Aug. 2	α Tauri	71	62	74
1863, Jan. 27	δ Arietis	250	234	245	13	13 Libræ	208	225	207
27	δ Arietis	107	91	102	Nov. 10	30 Capricor.	323	306	318
Mar. 2	α Cancri	301	317	298	Dec. 14	ξ^2 Ceti	91	72	91
Apr. 29	e Leonis	241	264	242	1870, Feb. 11	χ^2 Orionis	351	351	356
29	e Leonis	130	153	131	11	χ^2 Orionis	7	6	11
Oct. 22	κ Aquarii	298	277	298	Aug. 9	4 Capricor.	328	316	324
23	16 Piscium	207	184	205	Oct. 1	117 B. Sagittarii	310	303	305
30	χ^1 Orionis	275	274	271	Nov. 9	68 Tauri	311	301	315
30	χ^1 Orionis	82	81	78	9	68 Tauri	28	17	31
Dec. 19	π Piscium	317	295	312	1871, Oct. 23	69 Aquarii	325	303	324
1864, Mar. 18	A^2 Cancri	279	294	278	23	τ Aquarii	273	251	272
19	ω Leonis	98	115	97	23	τ Aquarii	72	50	91
Apr. 11	57 Orionis	120	119	116	Nov. 15	λ Sagittarii	280	278	274
1866, Jan. 8	h Virginis	352	13	357	18	ι Capricor.	211	193	209
8	h Virginis	9	31	14	27	ι Tauri	275	268	280
Feb. 27	h Leonis	279	297	282	Dec. 1	γ Cancri	260	274	264
1867, Nov. 6	λ Aquarii	269	247	264	1	γ Cancri	109	123	112
8	10 Ceti	269	246	264	20	ν Piscium	208	187	211
1868, Sept. 7	f Tauri	237	219	233	1872, Jan. 23	ω Geminor.	203	208	208
8	θ^2 Tauri	252	242	253	May 22	ω^2 Scorpii	86	98	81
8	θ^1 Tauri	229	220	230	Aug. 12	λ Libræ	259	271	254
9	111 Tauri	334	329	336	Sept. 15	69 Aquarii	283	261	283
1869, Jan. 24	119 Tauri	219	215	222	15	τ Aquarii	248	225	248
24	119 Tauri	129	125	132	15	τ Aquarii	96	73	96

RADCLIFFE—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1872, Oct. 11	35 Capricor.	328	311	327	1874, Apr. 22	ω Cancri	236	247	237
Dec. 9	f Piscium	124	101	127	22	4 Cancri	290	302	291
1873, Jan. 22	28 Libræ	241	257	236	Dec. 16	29 Piscium	233	210	238
Apr. 2	118 Tauri (S)	252	248	256	19	π Arietis	282	265	287
2	118 Tauri (N)	252	248	256	1875, Jan. 16	63 Arietis	255	240	259
July 4	λ Virginis	318	337	313	20	c Geminor.	304	313	304
Oct. 3	69 Aquarii	283	261	285	May 12	37 Leonis	334	357	331
Dec. 24	τ Aquarii	293	271	295	Oct. 24	σ Leonis	145	168	141
1874, Jan. 25	53 Arietis	234	217	239	Nov. 8	χ Aquarii	319	296	324
26	A Tauri	284	273	289	1876, Feb. 2	27 Arietis	289	271	294
27	k Tauri	270	264	275	2	27 Arietis	52	33	56
30	c Geminor.	218	227	220	Apr. 1	47 Geminor.	348	354	347
Mar. 26	λ Cancri	323	336	324	July 13	ε Piscium	293	270	298

SANTIAGO.

1892, June 14	κ Capricor.	131	112	131	1896, Apr. 1	α Scorpii	241	251	241
July 13	ψ^2 Aquarii	276	253	279	1	α Scorpii	140	150	141
13	ψ^2 Aquarii	72	49	75	1	116 B. Scorpii	226	236	227
Aug. 2	ρ Ophiuchi	239	249	234	1	116 B. Scorpii	155	165	156
4	66 B. Sagittarii	291	290	288	17	β Tauri	351	347	349
Sept. 7	10 Ceti	36	13	40	17	β Tauri	16	12	14
Oct. 4	27 Piscium	259	236	263	May 1	201 B. Sagittarii	95	88	98
1894, Feb. 15	κ Aurigæ	239	240	240	26	α Scorpii	290	300	291
16	ι Geminor.	321	329	321	July 19	A^2 Scorpii	239	251	239
16	ι Geminor.	57	65	56	1897, Jan. 11	15 Arietis	264	244	265
16	b^2 Geminor.	230	238	229	18	η Cancri	67	81	62
26	σ Scorpii	337	347	334	May 11	75 Leonis	221	244	217
26	σ Scorpii	53	63	50	July 20	η Piscium	281	259	282
Mar. 17	ξ Cancri	232	248	229	20	η Piscium	56	34	57
17	90 H^1. Cancri	261	277	258	Aug. 1	359 B. Leonis	271	294	267
1896, Jan. 22	ι Arietis	210	189	213	14	16 Piscium	139	116	142
26	116 B. Aurigæ	250	247	248	17	ι Arietis	80	59	80
27	25 Geminor.	304	307	301					

STRASSBURG.

1873, Apr. 2	118 Tauri (S)	252	248	256	1876, July 16	Anon. 10	184	171	187
2	118 Tauri (N)	251	247	256	16	Anon. 24	210	197	213
1874, Aug. 31	29 Arietis	52	33	57	Oct. 5	ε Arietis	242	225	245
Oct. 25	π Arietis	268	251	274	5	ε Arietis	110	93	113
25	π Arietis	76	59	82	6	17 Tauri	243	230	246
1875, Dec. 9	19 Arietis	257	237	261	6	17 Tauri	96	83	99
1876, Jan. 7	Anon. 19	247	234	251	6	23 Tauri	309	296	312
7	Anon. 25	291	278	294	6	23 Tauri	31	18	33
7	Anon. 22	226	213	229	6	20 Tauri	201	188	204
7	Anon. 13	192	179	195	6	20 Tauri	136	123	139
7	26 Tauri	268	255	271	6	24 Tauri	291	278	293
7	Anon. 30	267	254	270	6	24 Tauri	48	35	50
7	27 Tauri	233	220	236	6	η Tauri	297	284	299
7	28 Tauri	214	201	217	6	η Tauri	42	29	45
7	Anon. 40	282	269	285	6	Anon. 1	70	57	73
7	27 Tauri	109	96	112	6	Anon. 15	52	39	55
10	47 Geminor.	285	291	284	6	Anon. 18	54	41	56
Apr. 4	34 Leonis	262	282	257	6	Anon. 24	80	67	82
7	f Virginis	288	311	283	6	Anon. 27	71	58	74
June 5	65 B. Scorpii	239	251	238	6	Anon. 29	72	59	74
29	i Virginis	266	288	262	6	Anon. 31	67	54	69
July 16	Anon. 1	225	212	228	6	Anon. 32	62	49	64
16	Anon. 1	114	101	117	6	Anon. 37	42	29	44
16	Anon. 7	106	93	109	6	Anon. 39	63	50	65
16	23 Tauri	260	247	263	1877, Mar. 23	κ Geminor.	315	325	312
16	23 Tauri	79	66	81	26	ρ Leonis	134	155	129
16	Anon. 9	204	191	206	Apr. 26	85 Virginis	218	239	215
16	Anon. 8	200	187	203	May 31	17 Capricor.	60	46	65
16	24 Tauri	246	233	249	Aug. 29	μ Arietis	62	44	64
16	η Tauri	251	238	254	30	21 Tauri	36	23	36

STRASSBURG—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1877, Sept. 18	30 Capricor.	221	204	226	1880, Oct. 15	16 Piscium	252	229	253
Nov. 20	q Tauri	94	81	94	1881, Jan. 9	ζ Arietis	226	211	222
20	20 Tauri	63	50	63	July 5	83 Virginis	294	315	297
1878, Feb. 15	η Cancri	217	230	212	1882, Nov. 2	κ Cancri	246	262	245
15	η Cancri	149	162	144	2	κ Cancri	117	133	116
Mar. 16	A Leonis	334	354	329	1883, Jan. 4	κ Libræ	239	252	244
Apr. 13	48 Leonis	278	299	273	12	κ Aquarii	283	262	281
May 26	51 Piscium	96	73	99	May 17	χ Virginis	262	285	266
June 27	χ Tauri	94	84	92	Sept. 14	c^1 Capricor.	188	169	186
Sept. 6	51 Sagittarii	297	288	302	1884, Mar. 3	δ Tauri	256	246	252
Oct. 5	θ Capricor.	251	235	256	3	64 Tauri	278	268	274
Nov. 10	17 Tauri	279	266	277	July 11	θ Aquarii	290	269	287
10	20 Tauri	241	228	239	11	θ Aquarii	70	49	66
10	17 Tauri	67	54	65	Aug. 15	115 Tauri	90	86	88
10	16 Tauri	106	93	104	1885, Jan. 22	c Piscium	293	271	288
10	20 Tauri	108	95	106	22	c Piscium	66	44	61
1879, Jan. 6	139 Tauri	336	335	332	28	λ Geminor.	259	266	260
Apr. 4	p^5 Leonis	306	328	303	Feb. 23	130 Tauri	258	256	257
July 28	α Scorpii	209	219	213	23	130 Tauri	114	112	113
28	α Scorpii	133	143	137	1886, Apr. 8	α Tauri	232	223	232
Aug. 9	ε Arietis	73	56	71	8	α Tauri	134	125	133
10	27 Tauri	202	189	199	14	48 Leonis	320	341	325
10	Anon. 22	143	130	140	Aug. 8	24 Scorpii	259	267	258
10	Anon. 17	93	80	90	8	24 Scorpii	104	112	104
10	Anon. 19	110	97	107	Nov. 12	γ Tauri	292	282	292
10	27 Tauri	147	134	144	12	γ Tauri	54	44	54
10	26 Tauri	96	83	93	1887, Jan. 6	θ^2 Tauri	322	312	322
10	Anon. 34	50	37	47	6	θ^2 Tauri	28	18	28
10	Anon. 38	78	65	75	6	θ^1 Tauri	56	46	56
10	Anon. 40	88	75	85	Feb. 7	θ Cancri	204	219	209
Oct. 4	36 Tauri	84	72	81	7	θ Cancri	142	157	147
24	θ Aquarii	255	234	259	July 1	η Libræ	331	334	330
24	θ Aquarii	78	57	82	1	η Libræ	37	50	36
30	ε Arietis	125	109	123	6	ο Capricor.	67	54	62
1880, Jan. 16	19 Piscium	259	236	261	8	43 Aquarii	40	19	35
28	π Leonis	256	275	252	16	α Tauri	212	203	214
28	π Leonis	131	150	127	16	α Tauri	133	124	135
Feb. 12	9 Piscium	280	257	282	Aug. 12	γ Tauri	287	277	288
Mar. 18	132 Tauri	253	251	248	Oct. 12	α Leonis	277	297	282
21	d^2 Cancri	248	261	243	1898, Mar. 13	α Scorpii	256	266	260
Apr. 11	47 Arietis	255	238	252	13	α Scorpii	105	115	109

TOKIO.

1905, Jan. 16	264 B. Tauri	269	260	268	1905, Aug. 12	226 B. Sagittarii	255	247	251
16	269 B. Tauri	282	273	282	Sept. 11	σ Aquarii	67	46	62
16	264 B. Tauri	75	65	74	1906, Jan. 6	α Tauri	271	263	273
17	α Tauri	276	267	276	13	α Leonis	254	275	260
17	α Tauri	81	72	81	13	α Leonis	98	118	103
Feb. 20	c Leonis	52	75	57	Mar. 31	71 Orionis	324	323	323
Mar. 18	44 Leonis	308	330	314					

UTRECHT.

1904, Feb. 24	α Tauri	262	253	260	1905, Feb. 21	η Virginis	42	65	46
Aug. 27	20 Piscium	260	237	255	Mar. 15	110 B. Geminor.	242	247	244
Sept. 2	89 Tauri	275	266	274	20	β Virginis	306	329	311
2	σ^2 Tauri	318	309	317	20	β Virginis	53	76	58
27	85 Ceti	258	240	255	Sept. 17	μ Ceti	243	225	242
27	85 Ceti	96	78	93	17	μ Ceti	108	91	107
Dec. 20	75 Tauri	231	221	230	18	f Tauri	262	247	261
1905, Feb. 13	θ^1 Tauri	249	239	248	18	f Tauri	90	76	89
17	23 H^1. Cancri	285	297	288	Dec. 10	γ Tauri	277	267	278

VIENNA.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1869, Jan. 23	θ¹ Tauri	309	299	311	1876, June 30	43 H. Virginis	280	299	276
23	264 B. Tauri	288	278	289	1877, Mar. 26	ρ Leonis	242	263	237
23	α Tauri	287	278	288	Sept. 18	30 Capricor.	235	218	240
Apr. 16	119 Tauri	309	306	313	1878, Jan. 10	51 Piscium	293	270	297
1872, May 17	ν Virginis	254	277	253	Mar. 7	101 Piscium	273	251	275
Aug. 15	σ Sagittarii	246	241	241	16	A Leonis	319	339	314
1873, Apr. 2	118 Tauri	243	239	247	Apr. 9	37 Geminor.	283	288	279
1875, Sept. 12	33 Capricor.	310	293	313	Aug. 6	4 Scorpii	212	224	214
Dec. 7	44 Piscium	237	214	242	Sept. 6	51 Sagittarii	309	300	314
9	19 Arietis	270	250	275	1879, Feb. 26	26 Arietis	277	258	276
1876, Apr. 1	47 Geminor.	332	338	330	Apr. 1	θ Cancri	242	255	237
June 29	ι Virginis	261	283	257					

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1839, June 23	b Scorpii	278	290	276	1862, Mar. 10	56 Geminor.	217	224	212
July 6	20 Tauri	195	183	197	May 8	55 Leonis	278	300	277
6	17 Tauri	100	88	102	11	75 Virginis	287	309	290
6	η Tauri	292	280	294	Aug. 1	75 Virginis	266	288	269
6	20 Tauri	140	128	142	Oct. 29	13 Capricor.	232	218	236
Sept. 26	20 Tauri	252	240	254	29	τ Capricor.	243	229	247
26	17 Tauri	56	44	57	1863, Feb. 23	δ Arietis	235	219	230
26	16 Tauri	91	79	93	Mar. 22	40 Arietis	254	237	250
26	q Tauri	121	109	122	Apr. 9	36 Sagittarii	118	113	122
26	20 Tauri	86	74	88	21	105 Tauri	265	259	259
Oct. 17	δ Capricor.	202	184	207	25	29 Cancri	236	249	233
Nov. 19	ε Arietis	292	276	294	30	q Virginis	291	314	294
20	17 Tauri	255	243	256	Aug. 24	29 Sagittarii	202	198	206
20	η Tauri	308	296	310	27	c¹ Capricor.	243	224	244
20	η Tauri	30	18	31	30	51 Piscium	289	266	286
Dec. 12	78 Aquarii	250	228	256	30	51 Piscium	63	40	61
1840, Jan. 20	α Leonis	46	65	41	Sept. 24	51 Aquarii	225	204	225
Apr. 19	τ Scorpii	325	333	326	Nov. 3	ω Leonis	288	306	288
19	τ Scorpii	34	42	35	19	9 Piscium	246	223	244
May 6	μ Cancri	310	320	306	19	κ Piscium	202	179	200
July 10	τ Scorpii	328	336	329	1864, Jan. 23	A¹ Cancri	279	293	277
Sept. 8	ι Capricor.	232	216	237	Feb. 13	53 Arietis	242	226	237
Oct. 13	η Tauri	28	16	27	14	43 Tauri	330	319	325
Nov. 2	ι Capricor.	237	221	242	14	43 Tauri	52	41	47
2	ι Capricor.	87	71	93	16	χ Orionis	281	280	277
3	e Aquarii	262	243	267	16	χ Orionis	101	100	97
1841, June 4	p Sagittarii	71	73	74	25	49 Virginis	172	194	176
Aug. 1	19 Capricor.	282	268	288	May 20	χ Libræ	245	258	249
Sept. 6	17 Tauri	293	281	291	June 20	d Sagittarii	356	349	358
6	16 Tauri	255	243	253	July 23	62 Piscium	30	7	26
6	q Tauri	222	210	220	23	δ Piscium	268	245	264
6	20 Tauri	256	244	254	23	δ Piscium	81	58	77
6	17 Tauri	52	40	50	Aug. 12	ξ Ophiuchi	280	285	284
6	16 Tauri	90	78	88	Nov. 4	ρ Sagittarii	291	284	293
6	q Tauri	122	110	120	5	16 B. Capricor.	307	295	309
6	20 Tauri	88	76	86	5	β Capricor.	314	301	314
6	21 Tauri	128	116	126	1865, Jan. 12	A¹ Cancri	266	280	260
6	22 Tauri	118	106	117	Feb. 2	σ Arietis	292	275	288
25	21 Capricor.	254	239	259	Sept. 11	115 Tauri	31	27	28
Oct. 6	ε Geminor.	51	54	47	29	16 B. Capricor.	285	273	285
Nov. 27	17 Tauri	278	266	276	29	β Capricor.	289	277	288
27	16 Tauri	298	276	296	Oct. 12	60 Cancri	315	330	317
27	20 Tauri	243	231	241	12	60 Cancri	43	58	45
27	q Tauri	336	324	333	12	α Cancri	217	232	218
1842, Jan. 21	16 Tauri	276	264	273	12	α Cancri	144	159	145
21	q Tauri	247	235	244	1866, Jan. 31	π Leonis	249	268	251
21	21 Tauri	240	228	238	Apr. 20	68 Geminor.	263	272	264
21	22 Tauri	248	236	246	June 18	75 Leonis	220	243	225
24	ω Geminor.	252	257	250	July 31	44 Piscium	247	224	242
1862, Feb. 4	101 Piscium	322	300	320	31	44 Piscium	117	94	112

WASHINGTON—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1866, Dec. 24	ξ Leonis	196	214	200
24	ξ Leonis	155	173	159
1867, Apr. 8	318 B. Tauri	264	257	263
18	96 Virginis	289	309	293
18	96 Virginis	82	102	86
May 5	α Tauri	286	277	284
5	α Tauri	87	78	86
July 9	κ Virginis	285	305	288
9	κ Virginis	81	101	85
1868, May 22	α Tauri	297	288	298
June 24	49 Leonis	316	337	321
July 1	24 Scorpii	233	242	232
Sept. 28	64 Aquarii	207	186	203
1869, Jan. 28	α Leonis	265	285	270
28	α Leonis	104	124	108
Feb. 15	29 Ceti	273	251	270
15	33 Ceti	237	215	235
19	75 Tauri	282	272	283
1870, Jan. 5	182 B. Aquarii	234	213	230
Feb. 7	μ Ceti	274	256	275
12	ζ Geminor.	337	343	343
Mar. 10	χ^1 Orionis	333	332	337
10	χ^1 Orionis	32	31	36
Sept. 6	η Capricor.	313	297	308
1871, Feb. 28	141 Tauri	244	243	248
June 29	ν Scorpii	305	316	300
Sept. 7	3 Geminor.	70	70	75
22	χ Sagittarii	234	226	230
27	33 Piscium	69	46	69
Oct. 3	ι Tauri	268	262	274
3	ι Tauri	63	57	69
21	χ Capricor.	260	245	258
27	64 Ceti	211	191	214
Dec. 18	24 B. Ceti	284	261	285
1872, Feb. 21	γ Cancri	336	350	339
21	γ Cancri	10	24	14
Apr. 25	22 Ophiuchi	103	110	98
Sept. 21	ω Tauri	301	290	306
21	ω Tauri	27	16	32
21	53 Tauri	232	222	238
24	37 Geminor.	97	102	102
Oct. 15	33 Ceti	258	236	262
15	f Piscium	282	260	286
1873, Feb. 5	67 Tauri	212	202	217
28	14 Ceti	234	211	237
Mar. 1	μ Piscium	245	223	249
5	103 Tauri	274	268	278
Aug. 6	ω Sagittarii	270	260	268
6	A Sagittarii	274	264	272
1874, Aug. 20	α Scorpii	295	305	290
Dec. 19	45 Arietis	235	218	240
1875, Aug. 13	234 B. Sagittarii	267	259	267
Sept. 10	A Sagittarii	238	228	240
14	χ Aquarii	236	213	241
14	χ Aquarii	112	89	117
Oct. 3	A Scorpii	267	279	263
3	3 Scorpii	236	248	233
20	ω Cancri	71	82	69
Nov. 16	c Geminor.	322	331	321
1876, Jan. 1	70 Aquarii	60	38	64
10	c Geminor.	238	248	236
10	c Geminor.	143	153	142
Feb. 16	A Scorpii	129	142	127
16	π Scorpii	301	313	298
Mar. 4	49 Aurigæ	331	334	331
4	49 Aurigæ	29	32	29
5	c Geminor.	324	334	323
5	c Geminor.	56	66	54
May 4	f Virginis	249	272	244
June 1	50 Virginis	259	281	254
1876, Oct. 27	64 Aquarii	225	204	231
Nov. 23	42 Aquarii	246	225	250
24	81 Aquarii	206	184	212
Dec. 26	μ Arietis	251	233	254
27	q Tauri	300	287	302
1877, Apr. 22	45 Leonis	262	283	257
22	45 Leonis	133	154	128
July 6	16 Tauri	287	274	288
6	16 Tauri	54	41	55
6	q Tauri	258	245	259
6	q Tauri	82	69	83
6	Anon. 4	294	281	295
6	Anon. 4	46	33	47
6	20 Tauri	291	278	292
6	20 Tauri	49	36	50
6	21 Tauri	253	240	254
6	22 Tauri	261	248	262
6	22 Tauri	77	64	78
6	Anon. 12	281	268	282
6	Anon. 6	33	20	34
6	Anon. 2	74	61	75
Sept. 25	μ Arietis	301	283	303
1878, June 14	3 Sagittarii	216	218	219
14	3 Sagittarii	154	156	157
Sept. 5	σ Sagittarii	235	230	239
17	χ Tauri	82	71	80
Nov. 10	η Tauri	104	91	102
13	ε Geminor.	267	270	262
13	ε Geminor.	85	89	81
13	ε Geminor.	266	270	263
13	ε Geminor.	85	89	81
Dec. 2	λ Piscium	76	53	80
7	q Tauri	268	255	266
7	20 Tauri	299	286	297
1879, Feb. 3	ε Geminor.	273	276	268
28	χ Tauri	309	299	306
28	χ Tauri	65	55	62
Apr. 25	125 Tauri	261	258	257
26	52 B. Geminor.	249	252	245
May 28	34 Sextantis	260	282	256
June 30	48 B. Scorpii	252	264	256
Aug. 28	o Capricor.	205	192	210
Sept. 6	η Tauri	235	222	232
6	27 Tauri	277	264	274
6	28 Tauri	259	246	256
6	23 Tauri	248	235	245
6	24 Tauri	117	104	114
6	η Tauri	112	99	109
6	26 Tauri	24	11	21
6	27 Tauri	77	64	74
6	28 Tauri	95	82	92
6	23 Tauri	96	83	93
6	Anon. 7	128	115	125
Nov. 16	λ Sagittarii	337	334	342
16	λ Sagittarii	356	353	360
Dec. 1	δ Geminor.	248	255	243
1	δ Geminor.	122	129	117
1880, Apr. 20	36 Sextantis	299	321	296
20	36 Sextantis	91	113	88
Sept. 12	117 B. Sagittarii	227	224	232
14	47 B. Capricor.	198	185	203
17	κ Piscium	308	285	310
1881, Jan. 7	101 Piscium	265	243	262
Feb. 6	32 Tauri	276	263	271
May 21	16 Piscium	53	30	52
July 18	27 Arietis	137	118	133
Aug. 15	δ Arietis	256	239	251
15	δ Arietis	94	78	90
1882, Sept. 20	21 Sagittarii	259	257	263
1883, Apr. 17	36 Sextantis	256	278	258

WASHINGTON—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1883, June 14	62 Virginis	301	323	306	1907, Mar. 22	ζ Geminor.	295	291	290
July 21	c^2 Capricor.	80	61	78	24	δ Cancri	303	308	298
Sept. 6	α Libræ	210	227	215	24	δ Cancri	85	90	80
6	α Libræ	135	152	140	Sept. 14	ξ Ophiuchi	221	234	225
6	8 Libræ	192	209	197	Oct. 24	333 B. Tauri	106	91	102
16	21 Piscium	331	308	328	24	107 Tauri	292	278	288
1884, Mar. 3	68 Tauri	121	111	117	24	107 Tauri	59	44	54
Apr. 4	α Cancri	192	208	194	Nov. 16	117 G. Piscium	203	180	202
6	34 Sextantis	307	329	311	Dec. 11	336 B. Aquarii	335	316	337
6	34 Sextantis	63	85	67	1908, Jan. 18	η Cancri	101	105	96
May 1	A^2 Cancri	283	298	284	18	39 Cancri	109	114	105
1	A^2 Cancri	91	106	92	18	40 Cancri	103	108	98
June 28	υ Leonis	290	313	295	29	21 G. Sagittarii	108	108	103
28	υ Leonis	73	96	78	Mar. 7	30 B. Tauri	247	233	250
1906, Apr. 6	σ Leonis	334	348	330	10	η Geminor.	204	205	209
6	σ Leonis	52	66	48	10	η Geminor.	141	142	146
May 2	α Leonis	249	259	244	Apr. 6	141 Tauri	214	214	219
3	χ Leonis	297	311	293	9	39 Cancri	323	337	327
8	η Libræ	359	14	0	9	40 Cancri	333	348	338
8	η Libræ	16	31	16	13	ν Virginis	266	289	267
11	36 Sagittarii	114	118	118	June 11	o Libræ	281	296	278
June 2	65 Virginis	330	348	328	15	49 Sagittarii	119	111	114
25	7 Leonis	267	276	262	16	36 B Capricor.	255	242	251
Sept. 1	ι Aquarii	221	211	226	16	36 B. Capricor.	107	93	102
1	ι Aquarii	128	118	133	July 17	30 Piscium	183	159	182
Oct. 8	64 Orionis	99	91	95	17	30 Piscium	162	139	162
Nov. 21	ι Capricor.	204	197	210	Aug. 3	88 Virginis	259	280	258
22	45 Aquarii	253	241	258	9	49 Sagittarii	238	230	232
1907, Feb. 22	15 Geminor.	230	223	226	10	36B. Capricor.	·253	240	249
22	16 Geminor.	303	296	299					

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1898, Nov. 22	19 Piscium	235	212	236	1900, July 11	ξ Sagittarii	300	295	304
1899, Apr. 15	η Gem	0	1	355	1901, Oct. 17	ξ Ophiuchi	328	333	332
17	3 Cancri	331	342	326	1902, Feb. 12	ε Piscium	317	294	312
19	h Leonis	302	320	298	14	σ Arietis	313	296	308
1900, Jan. 11	67 Tauri	319	309	314	16	ι Tauri	310	303	306
Feb. 6	δ Arietis	312	296	307	Apr. 21	α Virginis	296	318	301
6	δ Arietis	63	47	58	June 18	ν Scorpii	281	292	285
Mar. 5	40 Arietis	314	297	310	July 19	ρ Sagittarii	220	212	221
May 1	ι Tauri	287	281	282	1904, Feb. 24	α Tauri	259	250	257
July 11	33 Sagittarii	311	306	315	24	α Tauri	104	95	102

NOTE.—The values of m for the occultations observed at the Cape of Good Hope during the years 1834 to 1895 inclusive are incorrect, m' having been substituted for m in the formula for ϵ given on page 23. The error of m can not exceed 10°. The erroneous values of m are published as they were used in the computation of the coefficients of ϵ, the only ones depending on m. This error is of the nature of a small accidental error, and its effect on the final result is believed to be neglible.—F. B. R.

CHAPTER VIII.

EQUATIONS OF CONDITION, 1672–1747.

36. Had the present volume been arranged fully on the plan of that of 1878, tabular exhibits of the principal numbers employed in the reductions for parallax would have been given. But this exhibit would serve no purpose except for the revision of the work by correcting the adopted data. Now, such a number of preliminary corrections have been applied one after the other that no additional ones would be useful. The feeling of the writer is that the whole work well deserves being recomputed in great part. The labor of doing this would be much less than has been actually applied in the present work, because it could be done on a uniform system, the tabular places of the moon would be those derived from Hansen's tables after applying all the preliminary corrections necessary. The reductions for parallax should then be made with the definitive values of the lunar parallax. This question involves the decision upon the correct value of the compression of the geoid. The various values of this element have already been discussed. As the final outcome of this discussion the author is less confident than formerly that the value derived directly from geodetic measures of arcs of the parallel and the meridian should be given as little weight as Helmert has given them in deriving his value of the compression. This question belongs to the domain of geodesy, the data of which are continually improving in extent. We should expect that every year will throw more light on the subject. Theory also enters in, especially Clairaut's theorem on the relation between gravity and the compression. This subject would require a much more careful investigation than the author has ever been able to give it, and future geodesists will be in a better condition to reach a conclusion.

Whatever value of the compression be adopted the interesting question will still be whether it can be corrected by the occultations themselves. If so, the methods of correction can be readily derived from the discussions of the lunar parallax, etc., in our chapter on the corrections of Hansen's tables.

The author also deems it quite likely that the method of computing the reductions for parallax may be improved. A careful study of a subject like this often shows that one's predecessors have not adopted the best course at every point.

The probable inequalities of the lunar surface itself form another important set of quantities which have been ignored. These will be mentioned hereafter.

In arranging and solving the equations I have considered separately those made before and after 1750. The present chapter deals mainly with the earlier equations, but the form of the two groups is so nearly the same that we shall give such preliminary equations as are necessary to both series.

37. The coefficients of the equations of condition as found for each individual occultation have been formed by the formulæ and methods given in Chapter II. To facilitate their critical study the following statement of the meaning of the separate data is given:

The date, the place of observation, and the name of the star seem to require no explanation. Commonly the name of the star is that used in the author's Fundamental Catalogue and in the Catalogue of Zodiacal Stars of the American Ephemeris, but no rigorous rule has been followed.

The classification of the phases is twofold—immersion or disappearance indicated by I, and emersion or reappearance by E. When the occultation took place at the bright limb the letter B is added; for the dark limb no indication is given. Hence the absence of the letter B indicates a dark limb observation.

The symbols for the unknown quantities, nine in number, are at the top of each column of coefficients. Their significance is—

λ, the correction of the excess of mean longitude of the moon over that of the star. Assuming the position of the stars to be final, λ would be simply the correction to the moon's mean longitude.

κ, is equivalent to $-2e\delta\pi$, where π is the longitude of the perigee.

$i\theta$, is equivalent to $\sin i\,\delta\Omega$, where Ω is the longitude of the node.

i, correction to the inclination of the moon's orbit.

b_0, the correction of the moon's tabular latitude, measured perpendicularly to the plane of the orbit, relative to the corresponding latitude of the star. Assuming the center of gravity of the moon to revolve around the earth in a great circle, b_0 is the difference between the centers of mass and of figure of the moon together with any common correction that may be required to the latitude of all the zodiacal stars.

α_0, the correction to the absolute right ascension of the star. In combining the equations this will be the mean correction to all the right ascensions of the stars, or all the positions of the equinox.

δ_0, the correction to the declination of the star, or, in combining the different equations, the mean correction to the declination of all the stars.

ε, the correction to the tabular obliquity of the ecliptic as adopted in the author's Tables of the Sun.

P, the correction to the parallactic equation.

s', the apparent semidiameter of the moon as computed with the constant, $s_0=932''.58$.

D, the tabular apparent distance of the center of the moon from the star.

Assuming the elements and observations to be exact we should have $D=s'$. $s'-D$ is therefore taken as the constant term of the equation of condition.

The manipulation of the equations would have been somewhat facilitated by changing all the signs in the equations from immersion so as to make the coefficients of λ positive throughout, but it was judged preferable to secure that uniformity of system which results from always using the excess of s' over D with its actual sign.

38. Coefficients of Equations of Condition, 1672–1747.

GROUP I—1672–1686.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	$s'-D$	Wt.
												″	
1672, Aug. 2	Paris	τ Scorpii	I	−0.89	+0.96	0.00	+0.02	−0.02	−0.01	−0.14	+0.06	+2.3	0.3
1676, Feb. 29	Paris	e Leonis	E	+0.93	+0.52	+0.07	−0.47	+0.47	−0.07	+0.39	−0.01	+6.0	0.3
Mar. 18	Greenwich	ζ Arietis	I	−0.78	+0.88	−0.37	−0.32	−0.48	−0.06	+0.16	−0.29	−7.4	0.3
23	Greenwich	28 Geminor.	I	−0.69	+0.27	−0.64	+0.26	−0.69	+0.13	−0.17	−0.56	−5.8	0.3
Nov. 9	Greenwich	π Sagittarii	I	−0.97	−0.81	−0.43	+0.21	+0.48	−0.09	+0.15	−0.40	−3.0	0.3
1678, Sept. 24	Greenwich	45 Sagittarii	I	−1.02	−0.72	−0.14	+0.32	+0.35	−0.09	+0.14	−0.28	+4.1	0.3
1680, Sept. 13	Greenwich	α Tauri	IB	−1.07	−0.94	+0.12	−0.25	+0.28	−0.12	+0.12	+0.28	+1.6	0.3
13	Greenwich	α Tauri	E	+1.01	+0.89	+0.17	−0.38	+0.42	+0.20	−0.12	+0.39	−5.0	0.3
Nov. 7	Greenwich	α Tauri	E	+1.10	+0.99	+0.06	−0.13	+0.14	+0.18	−0.14	+0.12	+6.7	0.3
1682, Feb. 15	Paris	θ^1 Tauri	I	−1.08	−0.77	0.00	+0.08	−0.08	−0.17	+0.16	−0.10	+0.7	1.0
15	Paris	θ^2 Tauri	I	−1.04	−0.74	0.00	−0.28	+0.28	−0.08	+0.18	+0.21	+4.9	1.0
Mar. 14	Greenwich	γ Tauri	I	−1.05	−0.66	0.00	+0.19	−0.19	−0.17	+0.19	−0.21	−2.5	1.0
14	Greenwich	γ Tauri	EB	+1.02	+0.64	+0.01	+0.33	−0.33	+0.08	−0.19	−0.26	−0.7	0.3
1683, Feb. 5	Paris	γ Tauri	I	−0.70	−0.13	−0.21	−0.69	+0.72	+0.11	+0.16	+0.59	+2.0	1.0
5	Greenwich	γ Tauri	I	−0.80	−0.15	−0.18	−0.60	+0.62	+0.05	+0.18	+0.51	+1.2	1.0
Apr. 2	Greenwich	119 Tauri	I	−0.96	−0.33	−0.24	−0.31	+0.39	−0.05	+0.11	+0.33	+4.6	1.0
May 4	Greenwich	α Leonis	I	−0.69	−0.61	−0.75	+0.22	+0.78	−0.28	−0.13	+0.41	+2.3	1.0
4	Greenwich	α Leonis	EB	+0.87	+0.76	−0.60	+0.18	+0.62	−0.01	+0.20	+0.40	+2.2	0.3
1684, Dec. 21	Paris	μ Geminor.	IB	−0.30	+0.21	+0.94	+0.11	−0.95	−0.09	+0.02	−0.97	−2.7	1.0
21	Paris	μ Geminor.	E	+0.49	−0.35	+0.84	+0.10	−0.85	−0.06	−0.05	−0.80	−4.5	1.0
21	Paris	μ Geminor.	IB	−0.30	+0.21	+0.94	+0.11	−0.95	−0.08	+0.02	−0.97	−2.5	1.0
21	Paris	μ Geminor.	E	+0.49	−0.35	+0.84	+0.10	−0.85	−0.06	−0.05	−0.80	−4.0	1.0
1685, Oct. 17	Paris	1 Geminor.	IB	−0.89	+0.99	−0.08	+0.01	+0.08	+0.03	+0.10	0.00	+1.7	1.0
1686, June 25	Paris	167 B. Leonis	I	−0.76	+0.55	+0.10	−0.56	−0.57	+0.17	−0.29	−0.36	+2.9	1.0

GROUP II—1699–1720.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	$s'-D$	Wt.
												″	
1699, Aug. 18	Paris	α Tauri	IB	−0.59	−0.46	−0.29	+0.79	−0.84	−0.19	+0.07	−0.79	−4.5	1.0
18	Paris	α Tauri	E	+0.75	+0.59	−0.24	+0.68	−0.72	0.00	−0.09	−0.65	+2.7	1.0
1701, Sept. 22	Paris	α Tauri	IB	−0.56	+0.25	−0.29	−0.75	+0.81	+0.14	+0.13	+0.71	+1.3	1.0
22	Paris	α Tauri	E	+0.55	−0.24	−0.31	−0.76	+0.82	+0.16	−0.09	+0.78	−0.5	1.0
1705, Aug. 4	Paris	33 Capricor.	IB	−0.70	−0.56	−0.22	+0.74	−0.77	−0.29	+0.13	+0.50	+0.9	1.0
Sept. 2	Paris	τ Aquarii	I	−0.89	−0.78	+0.06	+0.60	−0.60	−0.38	+0.25	+0.19	−2.4	1.0
2	Paris	τ Aquarii	EB	+1.04	+0.92	+0.04	+0.33	−0.33	+0.07	−0.37	+0.21	−3.8	0.3
1706, Jan. 27	Paris	λ Cancri	I	−0.80	+0.27	+0.21	−0.51	−0.55	+0.02	−0.14	−0.53	+1.3	1.0
Apr. 21	Paris	η Leonis	I	−0.76	+0.46	−0.09	−0.58	−0.59	+0.16	−0.31	−0.37	−3.7	1.0
21	Paris	η Leonis	EB	+0.51	−0.31	−0.13	−0.83	−0.84	+0.29	+0.13	−0.48	+0.4	1.0
May 24	Paris	λ Virginis	I	−0.44	+0.47	−0.85	−0.17	−0.87	+0.34	−0.27	+0.46	−0.3	1.0
Nov. 17	Paris	o Piscium	I	−1.02	−0.90	−0.41	−0.08	+0.42	−0.03	+0.44	+0.12	+0.5	1.0
1707, Apr. 4	Paris	ρ Arietis	I	−0.42	−0.38	+0.37	−0.11	−0.39	+0.25	+0.32	−0.32	+7.9	0.3
Sept. 3	Paris	α Scorpii	I	−0.52	+0.58	−0.56	+0.60	−0.82	+0.14	−0.09	+0.75	−6.2	0.3
3	Paris	α Scorpii	EB	+0.56	−0.63	−0.52	+0.56	−0.77	+0.16	+0.12	+0.73	−0.8	1.0
1709, Apr. 20	Paris	τ Leonis	I	−0.82	−0.65	+0.66	0.00	+0.66	−0.48	−0.28	+0.17	−2.9	1.0
Sept. 23	Paris	20 Tauri	IB	−0.88	+0.02	+0.11	−0.46	−0.47	−0.20	+0.20	−0.37	+3.5	0.5
23	Paris	22 Tauri	E	+0.53	−0.01	+0.19	−0.82	−0.85	−0.13	−0.15	−0.71	−2.8	1.0
1710, Dec. 4	Paris	17 Tauri	I	−0.88	+0.79	+0.04	+0.23	+0.23	+0.04	+0.21	+0.24	+2.0	1.0
1711, Sept. 30	Paris	η Tauri	IB	−0.46	+0.52	+0.36	+0.78	+0.86	+0.16	+0.12	+0.75	−3.0	0.3
30	Paris	η Tauri	E	+0.48	−0.54	+0.34	+0.76	+0.84	+0.13	−0.09	+0.66	−0.7	1.0
1712, May 15	Paris	e Leonis	I	−0.55	−0.08	+0.39	−0.74	+0.84	−0.43	−0.15	+0.20	−5.2	1.0
1713, Dec. 1	Luxemburg	τ Tauri	I	−0.59	+0.10	−0.78	−0.14	−0.80	−0.09	+0.03	−0.70	−0.3	1.0
1714, Mar. 20	Luxemburg	247 B. Tauri	I	−0.65	−0.08	+0.76	+0.11	+0.77	+0.01	+0.06	+0.75	+2.4	1.0
21	Paris	o Tauri	I	−0.94	+0.11	+0.32	−0.03	+0.32	−0.07	−0.02	+0.40	−2.7	1.0
21	Luxemburg	o Tauri	I	−0.94	+0.11	+0.32	−0.03	+0.32	−0.07	−0.02	+0.40	−1.5	1.0
Apr. 6	Paris	ξ Sagittarii	E	+1.02	+0.59	+0.28	−0.14	−0.32	+0.11	−0.15	+0.23	+3.1	1.0
6	Luxemburg	ξ Sagittarii	E	+1.03	+0.59	+0.28	−0.16	−0.32	+0.12	−0.15	+0.23	+3.0	1.0
Sept. 27	Luxemburg	ω Tauri	E	+0.98	+0.49	−0.38	−0.01	−0.38	+0.08	−0.09	−0.42	+1.3	1.0
Oct. 2	Luxemburg	α Cancri	E	+0.85	−0.55	−0.16	+0.39	−0.42	+0.11	+0.24	−0.40	−2.2	1.0
1715, July 21	Paris	δ Piscium	IB	−0.87	−0.75	+0.49	+0.36	+0.61	+0.07	+0.30	+0.14	−5.9	0.3
Aug. 15	Paris	κ Aquarii	IB	−0.54	−0.30	−0.29	−0.81	−0.86	−0.35	+0.12	+0.39	−1.0	0.3
15	Paris	κ Aquarii	E	+0.76	+0.43	−0.24	−0.67	−0.71	−0.14	−0.27	+0.27	−5.4	0.3
Oct. 9	Paris	κ Aquarii	I	−0.86	−0.44	−0.23	−0.53	−0.58	−0.29	+0.24	+0.29	+6.5	0.3
Dec. 30	Paris	κ Aquarii	I	−0.95	−0.37	−0.19	−0.38	−0.42	−0.22	+0.26	+0.24	+1.6	1.0
1717, Sept. 25	Paris	α Tauri	IB	−1.07	−0.67	+0.04	−0.07	+0.08	−0.11	+0.12	+0.08	−7.4	0.3
25	Paris	α Tauri	E	+1.05	+0.66	+0.11	−0.20	+0.22	+0.14	−0.11	+0.19	+2.3	1.0
25	Luxemburg	α Tauri	IB	−1.07	−0.67	+0.04	−0.07	+0.08	−0.11	+0.12	+0.08	−3.6	0.3
25	Luxemburg	α Tauri	E	+1.05	+0.66	+0.11	−0.20	+0.22	+0.14	−0.11	+0.19	−0.8	1.0
1718, Feb. 9	Luxemburg	α Tauri	I	−1.04	−0.49	+0.07	−0.18	+0.19	−0.08	+0.12	+0.17	−0.8	1.0
Sept. 9	Luxemburg	337 B. Aquarii	IB	−0.59	+0.65	+0.76	−0.02	+0.76	+0.27	+0.24	−0.19	−1.0	0.5
9	Paris	337 B. Aquarii	IB	−0.58	+0.64	+0.76	−0.02	+0.76	+0.21	+0.24	−0.19	−1.6	0.5
1719, Apr. 22	Paris	α Tauri	I	−0.84	+0.30	+0.02	+0.49	−0.50	−0.09	+0.14	−0.50	+2.0	1.0
22	Paris	α Tauri	EB	+0.76	−0.27	+0.02	+0.62	−0.62	−0.08	−0.12	−0.55	−1.3	1.0
22	Luxemburg	α Tauri	I	−0.84	+0.30	+0.02	+0.49	−0.49	−0.09	+0.14	−0.50	+1.1	1.0
Aug. 21	Luxemburg	γ Libræ	I	−1.06	−0.83	+0.03	−0.26	−0.26	−0.09	−0.22	+0.18	+2.3	1.0
Oct. 30	Paris	α Tauri	E	+0.85	−0.63	+0.09	+0.40	−0.41	−0.08	−0.17	−0.33	−4.6	0.3
Nov. 26	Paris	γ Tauri	IB	−0.78	+0.68	−0.08	−0.51	+0.52	+0.12	+0.19	+0.42	−0.5	0.5
1720, Apr 20	Paris	γ Virginis	I	−0.29	−0.23	−0.60	+0.75	+0.96	−0.36	−0.04	−0.11	+2.5	1.0
20	Paris	γ Virginis	EB	+0.52	+0.41	−0.55	+0.69	+0.88	−0.23	+0.22	−0.08	−3.6	1.0

GROUP III—1725–1729.

1725, Feb. 19	Luxemburg	A Tauri	I	−1.10	−0.99	+0.16	−0.05	−0.17	−0.26	+0.27	−0.22	−2.3	1.0
1727, Feb. 27	St. Petersburg	9 Tauri	I	−1.02	−0.19	+0.01	−0.02	−0.02	−0.14	+0.27	−0.02	+6.5	0.3
Sept. 6	Paris	17 Tauri	E	+0.86	−0.16	−0.25	+0.51	+0.57	+0.21	−0.20	+0.47	+3.6	1.0
6	Paris	q Tauri	E	+0.79	−0.15	+0.26	−0.52	−0.58	−0.07	−0.24	−0.48	−1.1	1.0
6	Paris	20 Tauri	E	+0.98	−0.19	−0.01	+0.02	+0.02	+0.10	−0.27	+0.02	+3.5	1.0
1729, Dec. 3	St. Petersburg	17 Tauri	I	−0.87	+0.91	+0.07	+0.22	+0.23	+0.05	+0.19	+0.26	+1.1	1.0
3	St. Petersburg	16 Tauri	I	−0.77	+0.81	−0.14	−0.47	−0.49	−0.01	+0.18	−0.36	+3.5	1.0
3	St. Petersburg	20 Tauri	I	−0.59	+0.62	−0.23	−0.71	−0.75	−0.13	+0.12	−0.59	+1.1	1.0
3	St. Petersburg	23 Tauri	I	−0.26	+0.27	+0.30	+0.91	+0.96	+0.15	+0.07	+0.83	+1.4	1.0
3	St. Petersburg	η Tauri	I	−0.79	+0.82	+0.15	+0.46	+0.48	+0.09	+0.19	+0.45	+0.5	1.0
3	St. Petersburg	28 Tauri	I	−0.78	+0.82	+0.15	+0.47	+0.50	+0.09	+0.17	+0.48	+1.2	1.0
3	St. Petersburg	27 Tauri	I	−0.53	+0.56	+0.25	+0.77	+0.81	+0.13	+0.11	+0.73	+1.6	1.0

GROUP IV—1736–1739.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	$s'-D$	Wt.
												″	
1736, Apr. 14	St. Petersburg	α Tauri	I	−0.81	−0.13	+0.30	−0.54	+0.62	+0.02	+0.10	+0.56	−2.9	1.0
Aug. 1	St. Petersburg	α Tauri	IB	−0.99	+0.04	+0.07	−0.14	+0.16	−0.03	+0.12	+0.15	−3.4	1.0
Oct. 22	St. Petersburg	α Tauri	IB	−0.98	+0.22	−0.01	+0.02	−0.02	−0.03	+0.12	−0.01	−2.9	1.0
1737, May 7	St. Petersburg	ξ Leonis	I	−1.05	−0.61	+0.20	+0.10	−0.22	−0.07	−0.22	−0.16	−0.7	1.0
July 22	St. Petersburg	θ^1 Tauri	EB	+0.42	−0.33	−0.10	+0.88	−0.89	−0.16	−0.09	−0.79	+1.3	1.0
22	St. Petersburg	θ^2 Tauri	EB	+0.80	−0.63	−0.06	+0.49	−0.49	−0.10	−0.15	−0.43	−2.0	1.0
1738, Jan. 2	St. Petersburg	71 Tauri	I	−0.52	+0.54	−0.03	−0.81	+0.81	+0.18	+0.11	+0.70	+1.8	1.0
2	St. Petersburg	θ^1 Tauri	I	−0.90	+0.93	0.00	+0.03	−0.03	+0.04	+0.18	−0.08	0.0	1.0
2	St. Petersburg	θ^2 Tauri	I	−0.85	+0.87	−0.01	−0.35	+0.35	+0.09	+0.18	+0.27	+0.8	1.0
2	St. Petersburg	264 B. Tauri	I	−0.79	+0.82	+0.02	+0.47	−0.47	−0.04	+0.16	−0.48	+2.5	1.0
2	St. Petersburg	α Tauri	I	−0.52	+0.54	+0.06	+0.81	−0.81	−0.10	+0.09	−0.78	−1.1	1.0
2	St. Petersburg	α Tauri	EB	+0.49	−0.50	+0.06	+0.84	−0.84	−0.15	−0.10	−0.76	−0.5	1.0
2	Paris	α Tauri	I	−0.85	+0.87	+0.02	+0.33	−0.33	−0.01	+0.15	−0.35	+0.7	1.0
2	Paris	α Tauri	EB	+0.87	−0.90	+0.02	+0.24	−0.24	−0.09	−0.15	−0.19	0.0	1.0
Feb. 2	St. Petersburg	f Geminor.	I	−0.48	+0.19	+0.67	+0.56	−0.87	+0.05	−0.04	−0.83	−1.3	1.0
Aug. 8	St. Petersburg	71 Tauri	IB	−0.77	+0.86	−0.11	−0.49	+0.51	+0.14	+0.17	+0.42	−1.0	1.0
8	St. Petersburg	α Tauri	IB	−0.57	+0.64	+0.22	+0.74	−0.77	−0.11	+0.11	−0.75	+0.4	1.0
Oct. 2	St. Petersburg	α Tauri	IB	−0.72	+0.80	+0.20	+0.56	−0.59	−0.07	+0.14	−0.60	+3.6	1.0
2	St. Petersburg	α Tauri	E	+0.80	−0.89	+0.14	+0.41	−0.43	−0.13	−0.17	−0.35	−4.5	1.0
Dec. 23	Paris	α Tauri	I	−0.84	+0.88	−0.14	−0.33	+0.36	+0.10	+0.19	+0.28	+2.8	1.0
23	Paris	α Tauri	EB	+0.74	−0.78	−0.22	−0.53	+0.57	+0.07	−0.15	+0.58	−2.0	1.0
1739, Oct. 23	St. Petersburg	85 Geminor.	IB	−0.87	+0.98	+0.22	+0.01	−0.22	+0.06	−0.06	−0.28	+0.2	1.0
23	St. Petersburg	85 Geminor.	E	+0.89	−1.00	+0.10	0.00	−0.10	−0.03	+0.07	−0.02	−3.9	0.3
24	St. Petersburg	δ Cancri	IB	−0.89	+0.99	+0.05	−0.01	−0.05	+0.06	−0.14	−0.11	+4.4	0.3
24	St. Petersburg	δ Cancri	E	+0.89	−0.99	−0.07	+0.01	+0.07	−0.06	+0.14	+0.13	−6.4	0.3

GROUP V—1746–1747.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	$s'-D$	Wt.
1746, Mar. 26	St. Petersburg	17 Tauri	I	−0.92	+0.72	+0.04	−0.08	−0.09	−0.06	+0.25	−0.07	+0.2	1.0
26	St. Petersburg	16 Tauri	I	−0.53	+0.42	+0.37	−0.73	−0.82	−0.22	+0.12	−0.69	+0.9	1.0
26	St. Petersburg	23 Tauri	I	−0.56	+0.44	−0.36	+0.70	+0.79	+0.18	+0.19	+0.67	+2.1	1.0
26	St. Petersburg	24 Tauri	I	−0.87	+0.68	−0.14	+0.28	+0.31	+0.05	+0.26	+0.27	+2.2	1.0
26	St. Petersburg	η Tauri	I	−0.86	+0.67	−0.17	+0.33	+0.37	+0.06	+0.27	+0.32	0.0	1.0
26	St. Petersburg	28 Tauri	I	−0.80	+0.63	−0.22	+0.44	+0.49	+0.09	+0.25	+0.41	+2.0	1.0
26	St. Petersburg	Anon. 8	I	−0.90	+0.70	+0.08	−0.15	−0.17	−0.06	+0.25	−0.13	+1.2	1.0
26	St. Petersburg	Anon. 9	I	−0.91	+0.71	+0.07	−0.13	−0.15	−0.07	+0.26	−0.12	+1.7	1.0
26	St. Petersburg	Anon. 4	I	−0.45	+0.35	+0.39	−0.77	−0.87	−0.23	+0.10	−0.72	+0.6	1.0
26	St. Petersburg	Anon. 10	I	−0.85	+0.66	+0.17	−0.34	−0.38	−0.12	+0.24	−0.30	+0.6	1.0
26	St. Petersburg	Anon. 15	I	−0.89	+0.70	−0.11	+0.22	+0.25	+0.03	+0.27	+0.21	+1.0	1.0
26	St. Petersburg	Anon. 18	I	−0.90	+0.70	−0.12	+0.20	+0.22	+0.02	+0.27	+0.18	−0.6	1.0
26	St. Petersburg	Anon. 29	I	−0.83	+0.65	+0.20	−0.39	−0.44	−0.12	+0.20	−0.37	+2.6	1.0
1747, Jan. 20	St. Petersburg	16 Tauri	I	−0.45	+0.50	−0.20	+0.85	+0.87	+0.19	+0.15	+0.74	−0.5	1.0
20	St. Petersburg	q Tauri	I	−0.86	+0.96	−0.05	+0.25	+0.25	+0.06	+0.23	+0.24	+0.9	1.0
20	St. Petersburg	21 Tauri	I	−0.89	+0.99	0.00	0.00	0.00	0.00	+0.24	+0.02	−2.1	1.0
20	St. Petersburg	20 Tauri	I	−0.63	+0.70	−0.13	+0.70	+0.71	+0.16	+0.19	+0.61	−2.7	1.0
20	St. Petersburg	22 Tauri	I	−0.88	+0.98	−0.02	+0.12	+0.12	+0.03	+0.24	+0.11	+0.2	1.0
July 30	St. Petersburg	Anon. 4	E	+0.79	−0.84	−0.01	+0.48	+0.48	+0.11	−0.19	+0.34	−0.6	1.0
30	St. Petersburg	20 Tauri	E	+0.82	−0.86	−0.01	+0.42	+0.42	+0.09	−0.20	+0.32	+0.1	1.0
30	St. Petersburg	q Tauri	E	+0.89	−0.94	0.00	−0.14	−0.14	−0.03	−0.23	−0.16	+0.4	1.0

Conditional Equations Which Have Not Been Used on Account of Weakness or Discordances.

Date.		Place.	Star.		Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ
1676, Feb.	29	Paris		e Leonis	IB	−0.82	−0.46	+0.11	−0.7	+0.68	−0.44	−0.25	+0.13
June	29	Greenwich		κ Aquarii	E	+1.01	+0.02	+0.03	−0.1	−0.09	+0.08	−0.40	+0.32
Aug.	19	Greenwich		o Sagittarii	I	−0.93	−0.74	+0.48	−0.2	−0.52	−0.23	+0.14	+0.44
	31	Greenwich		Mars	IB	−0.81	+0.88	−0.43	0.0	−0.43	+0.02	+0.01	−0.35
	31	Greenwich		Mars	E	+0.89	−0.97	−0.19	0.0	−0.18	−0.01	+0.01	−0.28
1680, Jan.	16	Greenwich		α Cancri	IB	−0.95	+0.12	−0.15	−0.3	+0.34	−0.15	−0.20	−0.30
Nov.	7	Greenwich		α Tauri	IB	−1.17	−1.00	−0.01	0.0	−0.03	−0.26	+0.14	−0.03
1683, Feb.	5	Greenwich		γ Tauri	EB	+0.87	−0.14	−0.13	−0.5	+0.52	+0.18	−0.16	+0.51
Apr.	2	Greenwich	119	Tauri	EB	+0.98	−0.34	−0.15	...	+0.25	....	....	....
1690, July	2	Paris	27	Tauri	I	−1.05	−0.80	+0.15	−0.3	−0.35	−0.29	+0.24	−0.29
1709, Sept.	23	Paris		q Tauri	IB	−0.30	+0.01	+0.23	−0.9	−0.95	−0.25	+0.05	−0.80
	23	Paris	22	Tauri	IB	−0.36	+0.01	+0.22	−0.9	−0.93	−0.25	+0.06	−0.79
1710, Dec.	4	Paris	22	Tauri	I	−0.40	+0.33	−0.14	−0.9	−0.91	−0.20	+0.07	−0.75
	4	Paris	21	Tauri	I	−0.05	+0.04	−0.16	−1.0	−1.00	−0.21	−0.02	−0.85
1711, Sept.	30	Paris	20	Tauri	IB	−0.79	+0.88	−0.21	−0.5	−0.50	−0.08	+0.16	−0.36
	30	Paris		q Tauri	IB	−0.20	+0.22	−0.42	−0.9	−0.99	−0.18	+0.01	−0.80
1714, Apr.	6	Paris		ξ Sagittarii	IB	−0.98	−0.58	+0.26	−0.1	−0.30	−0.15	+0.14	+0.38
	6	Luxemburg		ξ Sagittarii	IB	−0.98	−0.58	+0.26	−0.1	−0.30	−0.15	+0.14	+0.38
1719, Apr.	22	Luxemburg		α Tauri	EB	+0.73	−0.26	+0.03	+0.6	−0.64	−0.08	−0.14	−0.57
Oct.	30	Luxemburg		α Tauri	I	−0.75	+0.56	+0.12	+0.6	−0.60	−0.12	+0.13	−0.60
	30	Luxemburg		α Tauri	E	+0.85	−0.63	+0.08	+0.4	−0.41	−0.05	−0.17	−0.33
1727, Sept.	6	Paris	17	Tauri	IB	−0.93	+0.20	−0.12	+0.2	+0.26	+0.01	+0.26	+0.22
	6	Paris	16	Tauri	IB	−0.89	+0.18	+0.18	−0.3	−0.39	−0.15	+0.23	−0.31
	6	Paris		q Tauri	IB	−0.57	+0.12	+0.36	−0.5	−0.82	−0.23	+0.11	−0.68
	6	Paris	20	Tauri	IB	−0.93	+0.18	+0.13	−0.2	−0.29	−0.13	+0.24	−0.24
	6	Paris	16	Tauri	E	+0.97	−0.19	+0.03	−0.1	−0.07	+0.05	−0.26	−0.07
1733, Mar.	22	St. Petersburg		ν Geminor.	I	−1.00	−0.50	−0.23	+0.1	−0.26	−0.09	−0.10	−0.19
	25	St. Petersburg		κ Cancri	I	−0.49	+0.06	+0.34	−0.8	+0.88	−0.28	−0.09	+0.66
1738, Aug.	8	St. Petersburg	71	Tauri	E	+0.69	−0.76	−0.15	−0.6	+0.66	+0.11	−0.13	+0.65
	8	St. Petersburg		θ^1 Tauri	IB	−0.88	+0.98	+0.06	+0.2	−0.26	−0.03	+0.18	−0.29
	8	St. Petersburg		θ^2 Tauri	IB	−0.91	+1.00	−0.03	−0.1	+0.12	+0.03	+0.19	+0.05

Discussion of the Equations of Condition, 1672–1747.

39. The fact that the moon's longitude is subject to fluctuations which can not as yet be expressed by any known formula prevents the general solution of the equations in their entirety. Even were this not the case the fact that seven of the unknown quantities vary with the time would render a single solution laborious. The point first stated renders it necessary to proceed by approximations. The first step is to determine the fluctuations in the mean longitude. This is facilitated by two circumstances. The first is the minuteness of the unknown quantities, which, with the exception of λ, are only small fractions of a second. The other is the smallness in the general mean of any correlation between the mean longitude and any of the other unknown quantities.

All the unknown quantities except λ are constant, or increase uniformly with the time. λ is therefore exceptional in being subject to unknown fluctuations. Our method of proceeding must therefore be by successive approximations. The first approximation will consist in determining λ, assuming that all the other unknown quantities vanish. As the latter are quite small, this proceeding will lead to a fairly precise correction of the mean longitude at various epochs. We shall divide the equations into groups extending through periods of time in which we may suppose the difference between the true values of λ and a value increasing uniformly with the time to be smaller than the probable error of the mean derived from the group. By representing these preliminary corrections to the mean longitude by a smooth curve we shall determine values which can replace λ in the equations. Each term containing λ is then to be carried over to the second member of its equation. We shall then have a system of simultaneous equations in which the unknowns will vary uniformly with the time.

By assigning to each unknown the form $x+yt$, all the equations could be solved by least squares as a single system. But this method would be so laborious that it is desirable to abbreviate it, which we can readily do without appreciably detracting from the weight of the final result. The process will consist in dividing the equations into groups, solving each group as if the unknown were a constant, and then, from the series of values thus obtained, finding the nearest expression increasing uniformly with the time. If we deem it remunerative we can reinsert these values in the normal equations and thus obtain a second approximation to the values of the unknowns. The question whether it is necessary to continue the approximations further can be considered later.

The divisions between the groups used in forming λ is shown by blank spaces, and the approximate mean epoch for each group will otherwise supply a sufficient guide in comparing the results.

The work of deriving the mean corrections λ consists in a solution by least squares of the several groups of equations for that unknown, all the other unknown quantities being supposed to vanish. As their values have been made as small as convenient by preliminary corrections, and as there is only a small systematic correlation between the corrections to the mean longitude and to the other elements, the preliminary values obtained in this way will probably differ from the best obtainable ones by quantities less than the probable amount of the accidental errors.

Thus if the equations be taken as expressed in the form

$$a\lambda = n,$$

the normal equation will be

$$[aa]\lambda = [an],$$

and the solution will be

$$\lambda = \frac{[an]}{[aa]}.$$

Equations in which the square of the coefficient a is less than 0.10 have been generally omitted, as the effect of systematic errors increases as their coefficient diminishes.

Systematic errors of phase.—The most troublesome feature of the equations is the systematic character of the errors to which certain of the observations are liable. Immersions at the dark limb, that is, before full moon, are indeed fairly free from such errors. Fortunately, these comprise nearly a majority of all the observations; but it is, on several accounts, desirable to utilize the entire series. The character of the systematic errors to which observations other than dark limb immersions are liable is readily seen. An observation of emersion is always liable to be recorded too late through the observer failing to catch the star at its first reappearance. We might suppose that a good observer should always know whether he has or has not actually seen the star emerge. But experience shows that, measured in this way, few or perhaps no observers are free from defects. As I have already remarked, experience shows that when an observer estimates an error of his observation, his estimate is commonly but a small fraction of the truth, perhaps between one-tenth and two-tenths.

In a phenomenon at the bright limb an immersion is necessarily recorded when the star disappears, which may be before it reaches the limb, and an emersion when it reappears, which may be after it has left the limb. The result of all three of these classes of systematic error is the same in sign; the actual distance of the star from the moon's center at the assigned moment is greater than the semidiameter. The residual of $s'-D$ will therefore always be negative in sign. We must, therefore, always look with suspicion on abnormal negative values of $s'-D$ in all three cases.

The liability to bright limb error varies of course with the quality of the telescope and the magnitude of the star. In the case of a star of the first magnitude, especially Aldebaran, the true phase should always be observed, yet exceptions appear now and then. The presumption is also in favor of any other first magnitude star being free from the error. We must also expect that, as the telescope has been improved, the number of defective observations of this class should diminish. This is found to be the case.

What was actually done was to make a general study of the residuals $s' - D$ throughout the whole series in order to ascertain the frequency of seemingly abnormal negative values in the cases under consideration, and to form some estimate of the law of their variability with the time and the magnitude of the star. But it was not found practicable to formulate a universal rule applicable to all cases. What I actually did was to reject the equations in which, all things considered, the absolute term seemed abnormally large, while also following the rule of rejecting observations which there was strong reason to suspect *a priori* might be defective from the cause in question, even when not discordant.

40. For the purpose of discussion the observations have been separated into two series, the first comprising all those made before 1750, the second those made after that epoch. The observations of the first series have been discussed very fully in the author's Researches already often quoted. But the work has been carefully revised and such of the additional unknowns as it seemed advisable to include have been added to the equations.

The revision commenced with the Paris school of astronomers, whose work began about 1670. The observations made previous to that epoch, principally by Hevelius, are not so precise as to repay the labor of any further revision. The results have therefore been accepted as they stand in the Researches.

The circumstances under which the original records of the earlier Paris observations were examined and worked up by the author in 1871 are detailed in the former work, as is also the method of determining the clock correction. This is the weakest point in all the earlier observations. The clock correction was determined either by a rude meridian observation with the quadrant, or by equal altitudes, or by a combination of the two, the position of the quadrant being corrected by the altitudes. In this way it may be supposed that a fairly good result is derived for the actual time of determination. But as the clocks were not compensated, the uncertainty continually increased when, as sometimes happened, more than an entire day elapsed between the determinations. On examining his former work the author found no necessity of making a redetermination of the clock corrections. With some possible exceptions the mean time of the observations are taken as found in the Researches. The principal modification made in the absolute terms are due to the application of the correction to the moon's position and to that of the stars. Especially the values of D have been recomputed.

In the first series the number of discordant observations, saying nothing of those seeming to be affected with unduly large errors, is larger in proportion than it should be. It was necessary to exclude a number of discordant equations. Owing to the importance of observations at this epoch the excluded ones are given in a separate list. It is not impossible that if a re-examination of the author's Researches were made several of these equations might be made available by changes in the clock corrections. It will be seen that only two values of the weight are assigned. We might say three, if we include the weight zero given to the discordant observations. These are 1 and 0.3. Greater refinement did not seem to be necessary. Of course the weights are not uniform in their relation to the probable error; all that has been aimed at has been to have them uniform for the groups into which the equations are separated. For the purpose of solution the occultations of this series are divided into five groups, separated by well-marked gaps.

41. *Corrections to the moon's mean longitude for the period 1672–1747.*—From the equations of condition the following equations for the determination of λ were formed according to the method which has been outlined in §39:—

Group.	Mean Epoch.	Equation.	
		″	″ ″
I	1681	$10.9\,\lambda = -13.9$	$\lambda = -1.3 \pm 1.0$
II	1710	$25.2\,\lambda = +8.6$	$\lambda = +0.3 \pm 0.5$
III	1727	$7.0\,\lambda = -1.1$	$\lambda = -0.2 \pm 0.9$
IV	1738	$14.0\,\lambda = -8.7$	$\lambda = -0.6 \pm 0.4$
V	1747	$13.4\,\lambda = -8.5$	$\lambda = -0.6 \pm 0.4$

42. To solve for the other unknowns these values of λ were interpolated to a smoothed-off curve, substituted in the equations of condition, and the terms containing them transposed to the second members. But before the normal equations were formed, the equations of condition were modified by multiplying all the coefficients of α_0 and δ_0 by 3, so that, instead of α and δ we have as the unknowns $\frac{1}{3}\alpha$, $\frac{1}{3}\delta$. The equations of condition thus modified are as follows:

GROUP I—1672–1686.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	n	Wt.
										″	
1672, Aug. 2	Paris	τ Scorpii	I	+0.96	0.00	−0.02	−0.03	−0.42	+0.06	+1.1	0.3
1676, Feb. 29	Paris	e Leonis	E	+0.52	+0.07	+0.47	−0.21	+1.17	−0.01	+7.2	0.3
Mar. 18	Greenwich	ζ Arietis	I	+0.88	−0.37	−0.48	−0.18	+0.48	−0.29	−8.4	0.3
23	Greenwich	28 Geminor.	I	+0.27	−0.64	−0.69	+0.39	−0.51	−0.56	−6.7	0.3
Nov. 9	Greenwich	π Sagittarii	I	−0.81	−0.43	+0.48	−0.27	+0.45	−0.40	−4.3	0.3
1678, Sept. 24	Greenwich	45 Sagittarii	I	−0.72	−0.14	+0.35	−0.27	+0.42	−0.28	+2.8	0.3
1680, Sept. 13	Greenwich	α Tauri	IB	−0.94	+0.12	+0.28	−0.36	+0.36	+0.28	+0.2	0.3
13	Greenwich	α Tauri	E	+0.89	+0.17	+0.42	+0.60	−0.36	+0.39	−3.7	0.3
Nov. 7	Greenwich	α Tauri	E	+0.99	+0.06	+0.14	+0.54	−0.42	+0.12	+8.1	0.3
1682, Feb. 15	Paris	θ^1 Tauri	I	−0.77	0.00	−0.08	−0.51	+0.48	−0.10	−0.6	1.0
15	Paris	θ^2 Tauri	I	−0.74	0.00	+0.28	−0.24	+0.54	+0.21	+3.7	1.0
Mar 14	Greenwich	γ Tauri	I	−0.66	0.00	−0.19	−0.51	+0.57	−0.21	−3.8	1.0
14	Greenwich	γ Tauri	EB	+0.64	+0.01	−0.33	+0.24	−0.57	−0.26	+0.5	0.3
1683, Feb. 5	Paris	γ Tauri	I	−0.13	−0.21	+0.72	+0.33	+0.48	+0.59	+1.2	1.0
5	Greenwich	γ Tauri	I	−0.15	−0.18	+0.62	+0.15	+0.54	+0.51	+0.3	1.0
Apr. 2	Greenwich	119 Tauri	I	−0.33	−0.24	+0.39	−0.15	+0.33	+0.33	+3.5	1.0
May 4	Greenwich	α Leonis	I	−0.61	−0.75	+0.78	−0.84	−0.39	+0.41	+1.5	1.0
4	Greenwich	α Leonis	EB	+0.76	−0.60	+0.62	−0.03	+0.60	+0.40	+3.2	0.3
1684, Dec. 21	Paris	μ Geminor.	IB	+0.21	+0.94	−0.95	−0.27	+0.06	−0.97	−3.0	1.0
21	Paris	μ Geminor.	E	−0.35	+0.84	−0.85	−0.18	−0.15	−0.80	−4.0	1.0
21	Paris	μ Geminor.	IB	+0.21	+0.94	−0.95	−0.24	+0.06	−0.97	−2.8	1.0
21	Paris	μ Geminor.	E	−0.35	+0.84	−0.85	−0.18	−0.15	−0.80	−3.5	1.0
1685, Oct. 17	Paris	1 Geminor.	IB	+0.99	−0.08	+0.08	+0.09	+0.30	0.00	+0.9	1.0
1686, June 25	Paris	167 B. Leonis	I	+0.55	+0.10	−0.57	+0.51	−0.87	−0.36	+2.2	1.0

GROUP II—1699–1720.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	n	Wt.
										″	
1699, Aug. 18	Paris	α Tauri	IB	−0.46	−0.29	−0.84	−0.57	+0.21	−0.79	−4.5	1.0
18	Paris	α Tauri	E	+0.59	−0.24	−0.72	0.00	−0.27	−0.65	+2.7	1.0
1701, Sept. 22	Paris	α Tauri	IB	+0.25	−0.29	+0.81	+0.42	+0.39	+0.71	+1.4	1.0
22	Paris	α Tauri	E	−0.24	−0.31	+0.82	+0.48	−0.27	+0.78	−0.6	1.0
1705, Aug. 4	Paris	33 Capricor.	IB	−0.56	−0.22	−0.77	−0.87	+0.39	+0.50	+1.0	1.0
Sept. 2	Paris	τ Aquarii	I	−0.78	+0.06	−0.60	−1.14	+0.75	+0.19	−2.2	1.0
2	Paris	τ Aquarii	EB	+0.92	+0.04	−0.33	+0.21	−1.11	+0.21	−4.0	0.3
1706, Jan. 27	Paris	λ Cancri	I	+0.27	+0.21	−0.55	+0.06	−0.42	−0.53	+1.5	1.0
Apr. 21	Paris	η Leonis	I	+0.46	−0.09	−0.59	+0.48	−0.93	−0.37	−3.5	1.0
21	Paris	η Leonis	EB	−0.31	−0.13	−0.84	+0.87	+0.39	−0.48	+0.3	1.0
May 24	Paris	λ Virginis	I	+0.47	−0.85	−0.87	+1.02	−0.81	+0.46	−0.2	1.0
Nov. 17	Paris	o Piscium	I	−0.90	−0.41	+0.42	−0.09	+1.32	+0.12	+0.7	1.0
1707, Apr. 4	Paris	ρ Arietis	I	−0.38	+0.37	−0.39	+0.75	+0.96	−0.32	+8.0	0.3
Sept. 3	Paris	α Scorpii	I	+0.58	−0.56	−0.82	+0.42	−0.27	+0.75	−6.1	0.3
3	Paris	α Scorpii	EB	−0.63	−0.52	−0.77	+0.48	+0.36	+0.73	−0.9	1.0
1709, Apr. 20	Paris	τ Leonis	I	−0.65	+0.66	+0.66	−1.44	−0.84	+0.17	−2.7	1.0
Sept. 23	Paris	20 Tauri	IB	+0.02	+0.11	−0.47	−0.60	+0.60	−0.37	+3.8	0.5
23	Paris	22 Tauri	E	−0.01	+0.19	−0.85	−0.39	−0.45	−0.71	−3.0	1.0
1710, Dec. 4	Paris	17 Tauri	I	+0.79	+0.04	+0.23	+0.12	+0.63	+0.24	+2.3	1.0
Sept. 30	Paris	η Tauri	IB	+0.52	+0.36	+0.86	+0.48	+0.36	+0.75	−2.9	0.3
30	Paris	η Tauri	E	−0.54	+0.34	+0.84	+0.39	−0.27	+0.66	−0.8	1.0
1712, May 15	Paris	e Leonis	I	−0.08	+0.39	+0.84	−1.29	−0.45	+0.20	−5.0	1.0
1713, Dec. 1	Luxemburg	τ Tauri	I	+0.10	−0.78	−0.80	−0.27	+0.09	−0.70	−0.1	1.0
1714, Mar. 20	Luxemburg	247 B. Tauri	I	−0.08	+0.76	+0.77	+0.03	+0.18	+0.75	+2.6	1.0
21	Paris	o Tauri	I	+0.11	+0.32	+0.32	−0.21	−0.06	+0.40	−2.4	1.0
21	Luxemburg	o Tauri	I	+0.11	+0.32	+0.32	−0.21	−0.06	+0.40	−1.2	1.0
Apr. 6	Paris	ξ Sagittarii	E	+0.59	+0.28	−0.32	+0.33	−0.45	+0.23	+2.8	1.0
6	Luxemburg	ξ Sagittarii	E	+0.59	+0.28	−0.32	+0.36	−0.45	+0.23	+2.7	1.0
Sept. 27	Luxemburg	ω Tauri	E	+0.49	−0.38	−0.38	+0.24	−0.27	−0.42	+1.0	1.0
Oct. 2	Luxemburg	α Cancri	E	−0.55	−0.16	−0.42	+0.33	+0.72	−0.40	−2.5	1.0
1715, July 21	Paris	δ Piscium	IB	−0.75	+0.49	+0.61	+0.21	+0.90	+0.14	−5.6	0.3
Aug. 15	Paris	κ Aquarii	IB	−0.30	−0.29	−0.86	−1.05	+0.36	+0.39	−0.8	0.3
15	Paris	κ Aquarii	E	+0.43	−0.24	−0.71	−0.42	−0.81	+0.27	−5.6	0.3
Oct. 9	Paris	κ Aquarii	I	−0.44	−0.23	−0.58	−0.87	+0.72	+0.29	+6.8	0.3
Dec. 30	Paris	κ Aquarii	I	−0.37	−0.19	−0.42	−0.66	+0.78	+0.24	+1.9	1.0
1717, Sept. 25	Paris	α Tauri	IB	−0.67	+0.04	+0.08	−0.33	+0.36	+0.08	−7.2	0.3
25	Paris	α Tauri	E	+0.66	+0.11	+0.22	+0.42	−0.33	+0.19	+2.1	1.0
25	Luxemburg	α Tauri	IB	−0.67	+0.04	+0.08	−0.33	+0.36	+0.08	−3.4	0.3
25	Luxemburg	α Tauri	E	+0.66	+0.11	+0.22	+0.42	−0.33	+0.19	−1.0	1.0
1718, Feb. 9	Luxemburg	α Tauri	I	−0.49	+0.07	+0.19	−0.24	+0.36	+0.17	−0.6	1.0
Sept. 9	Luxemburg	337 B. Aquarii	IB	+0.65	+0.76	+0.76	+0.81	+0.72	−0.19	−0.9	0.5
9	Paris	337 B. Aquarii	IB	+0.64	+0.76	+0.76	+0.63	+0.72	−0.19	−1.5	0.5
1719, Apr. 22	Paris	α Tauri	I	+0.30	+0.02	−0.50	−0.27	+0.42	−0.50	+2.2	1.0
22	Paris	α Tauri	EB	−0.27	+0.02	−0.62	−0.24	−0.36	−0.55	−1.5	1.0
22	Luxemburg	α Tauri	I	+0.30	+0.02	−0.49	−0.27	+0.42	−0.50	+1.3	1.0
Aug. 21	Luxemburg	γ Libræ	I	−0.83	+0.03	−0.26	−0.27	−0.66	+0.18	+2.5	1.0
Oct. 30	Paris	α Tauri	E	−0.63	+0.09	−0.41	−0.24	−0.51	−0.33	−4.8	0.3
Nov. 26	Paris	γ Tauri	IB	+0.68	−0.08	+0.52	+0.36	+0.57	+0.42	−0.3	0.5
1720, Apr. 20	Paris	γ Virginis	I	−0.23	−0.60	+0.96	−1.08	−0.12	−0.11	+2.6	1.0
20	Paris	γ Virginis	EB	+0.41	−0.55	+0.88	−0.69	+0.66	−0.08	−3.7	1.0

GROUP III—1725–1729.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	n	Wt.
1725, Feb. 19	Luxemburg	A Tauri	I	−0.99	+0.16	−0.17	−0.78	+0.81	−0.22	−2.4	1.0
1727, Feb. 27	St. Petersburg	9 Tauri	I	−0.19	+0.01	−0.02	−0.42	+0.81	−0.02	+6.3	0.3
Sept. 6	Paris	17 Tauri	E	−0.16	−0.25	+0.57	+0.63	−0.60	+0.47	+3.8	1.0
6	Paris	q Tauri	E	−0.15	+0.26	−0.58	−0.21	−0.72	−0.48	−0.9	1.0
6	Paris	20 Tauri	E	−0.19	−0.01	+0.02	+0.30	−0.81	+0.02	+3.7	1.0
1729, Dec. 3	St. Petersburg	17 Tauri	I	+0.91	+0.07	+0.23	+0.15	+0.57	+0.26	+0.8	1.0
3	St. Petersburg	16 Tauri	I	+0.81	−0.14	−0.49	−0.03	+0.54	−0.36	+3.3	1.0
3	St. Petersburg	20 Tauri	I	+0.62	−0.23	−0.75	−0.39	+0.36	−0.59	+0.9	1.0
3	St. Petersburg	23 Tauri	I	+0.27	+0.30	+0.96	+0.45	+0.21	+0.83	+1.3	1.0
3	St. Petersburg	η Tauri	I	+0.82	+0.15	+0.48	+0.27	+0.57	+0.45	+0.3	1.0
3	St. Petersburg	28 Tauri	I	+0.82	+0.15	+0.50	+0.27	+0.51	+0.48	+1.0	1.0
3	St. Petersburg	27 Tauri	I	+0.56	+0.25	+0.81	+0.39	+0.33	+0.73	+1.4	1.0

GROUP IV—1736–1739.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	n	Wt.
1736, Apr. 14	St. Petersburg	α Tauri	I	−0.13	+0.30	+0.62	+0.06	+0.30	+0.56	″ −3.4	1.0
Aug. 1	St. Petersburg	α Tauri	IB	+0.04	+0.07	+0.16	−0.09	+0.36	+0.15	−4.0	1.0
Oct. 22	St. Petersburg	α Tauri	IB	+0.22	−0.01	−0.02	−0.09	+0.36	−0.01	−3.5	1.0
1737, May 7	St. Petersburg	ξ Leonis	I	−0.61	+0.20	−0.22	−0.21	−0.66	−0.16	−1.3	1.0
July 22	St. Petersburg	θ^1 Tauri	EB	−0.33	−0.10	−0.89	−0.48	−0.27	−0.79	+1.6	1.0
22	St. Petersburg	θ^2 Tauri	EB	−0.63	−0.06	−0.49	−0.30	−0.45	−0.43	−1.5	1.0
1738, Jan. 2	St. Petersburg	71 Tauri	I	+0.54	−0.03	+0.81	+0.54	+0.33	+0.70	+1.5	1.0
2	St. Petersburg	θ^1 Tauri	I	+0.93	0.00	−0.03	+0.12	+0.54	−0.08	−0.5	1.0
2	St. Petersburg	θ^2 Tauri	I	+0.87	−0.01	+0.35	+0.27	+0.54	+0.27	+0.3	1.0
2	St. Petersburg	264 B. Tauri	I	+0.82	+0.02	−0.47	−0.12	+0.48	−0.48	+2.0	1.0
2	St. Petersburg	α Tauri	I	+0.54	+0.06	−0.81	−0.30	+0.27	−0.78	−1.4	1.0
2	St. Petersburg	α Tauri	EB	−0.50	+0.06	−0.84	−0.45	−0.30	−0.76	−0.2	1.0
2	Paris	α Tauri	I	+0.87	+0.02	−0.33	−0.03	+0.45	−0.35	+0.2	1.0
2	Paris	α Tauri	EB	−0.90	+0.02	−0.24	−0.27	−0.45	−0.19	+0.5	1.0
Feb. 2	St. Petersburg	f Geminor.	I	+0.19	+0.67	−0.87	+0.15	−0.12	−0.83	−1.6	1.0
Aug. 8	St. Petersburg	71 Tauri	IB	+0.86	−0.11	+0.51	+0.42	+0.51	+0.42	−1.5	1.0
8	St. Petersburg	α Tauri	IB	+0.64	+0.22	−0.77	−0.33	+0.33	−0.75	+0.1	1.0
Oct. 2	St. Petersburg	α Tauri	IB	+0.80	+0.20	−0.59	−0.21	+0.42	−0.60	+3.2	1.0
2	St. Petersburg	α Tauri	E	−0.89	+0.14	−0.43	−0.39	−0.51	−0.35	−4.0	1.0
Dec. 23	Paris	α Tauri	I	+0.88	−0.14	+0.36	+0.30	+0.57	+0.28	+2.3	1.0
23	Paris	α Tauri	EB	−0.78	−0.22	+0.57	+0.21	−0.45	+0.58	−1.6	1.0
1739, Oct. 23	St. Petersburg	85 Geminor.	IB	+0.98	+0.22	−0.22	+0.18	−0.18	−0.28	−0.3	1.0
23	St. Petersburg	85 Geminor.	E	−1.00	+0.10	−0.10	−0.09	+0.21	−0.02	−3.4	0.3
24	St. Petersburg	δ Cancri	IB	+0.99	+0.05	−0.05	+0.18	−0.42	−0.11	+3.9	0.3
24	St. Petersburg	δ Cancri	E	−0.99	−0.07	+0.07	−0.18	+0.42	+0.13	−5.9	0.3

GROUP V—1746–1747.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	n	Wt.
1746, Mar. 26	St. Petersburg	17 Tauri	I	+0.72	+0.04	−0.09	−0.18	+0.75	−0.07	−0.6	1.0
26	St. Petersburg	16 Tauri	I	+0.42	+0.37	−0.82	−0.66	+0.36	−0.69	+0.4	1.0
26	St. Petersburg	23 Tauri	I	+0.44	−0.36	+0.79	+0.54	+0.57	+0.67	+1.6	1.0
26	St. Petersburg	24 Tauri	I	+0.68	−0.14	+0.31	+0.15	+0.78	+0.27	+1.4	1.0
26	St. Petersburg	η Tauri	I	+0.67	−0.17	+0.37	+0.18	+0.81	+0.32	−0.8	1.0
26	St. Petersburg	28 Tauri	I	+0.63	−0.22	+0.49	+0.27	+0.75	+0.41	+1.3	1.0
26	St. Petersburg	Anon. 8	I	+0.70	+0.08	−0.17	−0.18	+0.75	−0.13	+0.4	1.0
26	St. Petersburg	Anon. 9	I	+0.71	+0.07	−0.15	−0.21	+0.78	−0.12	+0.9	1.0
26	St. Petersburg	Anon. 4	I	+0.35	+0.39	−0.87	−0.69	+0.30	−0.72	+0.2	1.0
26	St. Petersburg	Anon. 10	I	+0.66	+0.17	−0.38	−0.36	+0.72	−0.30	−0.2	1.0
26	St. Petersburg	Anon. 15	I	+0.70	−0.11	+0.25	+0.09	+0.81	+0.21	+0.2	1.0
26	St. Petersburg	Anon. 18	I	+0.70	−0.12	+0.22	+0.06	+0.81	+0.18	−1.4	1.0
26	St. Petersburg	Anon. 29	I	+0.65	+0.20	−0.44	−0.36	+0.60	−0.37	+1.9	1.0
1747, Jan. 20	St. Petersburg	16 Tauri	I	+0.50	−0.20	+0.87	+0.57	+0.45	+0.74	−0.9	1.0
20	St. Petersburg	q Tauri	I	+0.96	−0.05	+0.25	+0.18	+0.69	+0.24	+0.1	1.0
20	St. Petersburg	21 Tauri	I	+0.99	0.00	0.00	0.00	+0.72	+0.02	−2.9	1.0
20	St. Petersburg	20 Tauri	I	+0.70	−0.13	+0.71	+0.48	+0.57	+0.61	−3.3	1.0
20	St. Petersburg	22 Tauri	I	+0.98	−0.02	+0.12	+0.09	+0.72	+0.11	−0.6	1.0
July 30	St. Petersburg	Anon. 4	E	−0.84	−0.01	+0.48	+0.33	−0.57	+0.34	+0.1	1.0
30	St. Petersburg	20 Tauri	E	−0.86	−0.01	+0.42	+0.27	−0.60	+0.32	+0.8	1.0
30	St. Petersburg	q Tauri	E	−0.94	0.00	−0.14	−0.09	−0.69	−0.16	+1.2	1.0

43. From these equations of condition the following normal equations have been formed in the usual way:

Group.	Year.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	$[n]$
				Normal equations in κ.				″
I	1681	+ 5.75	+0.29	− 1.00	+ 2.31	− 1.58	−0.33	=+ 2.80
II	1710	+10.86	+0.37	+ 0.23	+ 5.19	− 3.85	−0.77	+ 6.19
III	1727	+ 4.67	+0.11	+ 1.03	+ 1.32	+ 1.83	+1.18	+ 7.00
IV	1738	+11.48	+0.40	+ 0.24	+ 2.02	+ 5.22	−0.43	+13.52
V	1747	+11.08	−0.23	+ 0.65	− 0.22	+10.01	+0.75	− 5.48
				Normal equations in $i\theta$.				
I	1681	....	+4.24	− 4.16	− 0.14	− 0.38	−3.66	=−11.67
II	1710	....	+5.70	+ 3.40	− 0.47	− 0.99	+0.78	− 1.02
III	1727	....	+0.42	+ 0.58	+ 0.09	+ 0.29	+0.50	− 1.25
IV	1738	....	+0.83	− 1.07	− 0.20	− 0.05	−1.05	− 2.44
V	1747	....	+0.68	− 1.63	− 1.17	− 0.36	−1.38	+ 0.48
				Normal equations in b_0.				
I	1681	....	....	+ 5.98	+ 0.09	+ 1.60	+4.97	=+19.79
II	1710	....	....	+15.97	− 1.03	+ 1.44	+5.46	+10.51
III	1727	....	....	+ 3.60	+ 1.97	+ 0.52	+3.12	+ 4.04
IV	1738	....	....	+ 6.67	+ 2.75	+ 1.13	+6.15	− 1.28
V	1747	....	....	+ 4.79	+ 3.40	+ 0.96	+3.99	− 2.60
				Normal equations in $\frac{1}{3}\alpha_0$.				
I	1681	....	....	....	+ 2.27	− 0.98	+0.64	=+ 3.97
II	1710	....	....	....	+14.24	− 1.27	+1.21	+11.92
III	1727	....	....	....	+ 1.85	− 0.76	+1.76	+ 5.92
IV	1738	....	....	....	+ 1.80	+ 1.06	+2.41	+ 2.29
V	1747	....	....	....	+ 2.48	− 0.05	+2.83	− 1.92
				Normal equations in $\frac{1}{3}\delta_0$.				
I	1681	....	....	....	....	+ 3.57	+0.89	=− 1.89
II	1710	....	....	....	....	+12.93	+0.03	+11.37
III	1727	....	....	....	....	+ 3.87	+0.52	− 1.07
IV	1738	....	....	....	....	+ 4.02	+0.73	+ 1.78
V	1747	....	....	....	....	+ 9.50	+1.00	− 2.99
				Normal equations in ϵ.				
I	1681	....	....	....	....	....	+4.60	=+17.50
II	1710	....	....	....	....	....	+8.49	+ 1.15
III	1727	....	....	....	....	....	+2.70	+ 3.99
IV	1738	....	....	....	....	....	+5.73	− 2.04
V	1747	....	....	....	....	....	+3.36	− 2.36

It will be seen that, owing to the irregular way in which the observations are scattered around the moon's orbit, the coefficients of the unknowns in the normal equations are very irregular, showing that a solution of each group separately will lead to results of little weight. On the other hand, if we combine the five sets of normal equations into a single one, the true values of the unknowns will not be the same in all the equations, because they vary with the time. Of course, one way of apparently evading this difficulty would be to multiply by the time to include its coefficient as additional unknowns, but the variations thus obtained would be very uncertain compared with those to be subsequently reached through all the occultations. The easiest way of surmounting the difficulty is the following:

Let x be any one of the unknowns. Let x_0 and x_1 be the values of x at the respective epochs 1850 and an arbitrary epoch near the mean of all the groups under consideration, say 1720. The value of x at an interval τ after 1720 will then be

$$x=x_1\left(1-\frac{\tau}{1.30}\right)+\frac{\tau}{1.30}x_0.$$

The value of x_0 is so small that, τ being a small factor sometimes positive and sometimes negative, the last term of this expression may be dropped and regarded as belonging to the accidental errors, the magnitude of which it will not increase in any appreciable degree. We may therefore replace x by the unknown x_1, its value at the mean epoch. The expressions to be used then become

$$\begin{array}{rl} \text{Group I} & x=1.28\,x_1 \\ \text{II} & x=1.05\,x_1 \\ \text{III} & x=0.94\,x_1 \\ \text{IV} & x=0.86\,x_1 \\ \text{V} & x=0.79\,x_1 \end{array}$$

44. We thus form a single set of normal equations by multiplying the terms of the partial normals already given by the appropriate factors and adding. Doing this, the final normals for the values of the unknowns at the mean epoch become:

κ	$i\theta$	b_0	$\frac{1}{3}a_0$	$\frac{1}{3}\delta_0$	ε	$[n]$
						″
+40.86	+ 1.15	+ 0.10	+12.01	+ 4.86	− 0.21	+23.96
+ 1.15	+14.62	− 4.37	− 1.55	− 1.71	− 6.34	−18.91
+ 0.10	− 4.37	+38.46	+ 4.90	+ 6.10	+23.93	+37.02
+12.01	− 1.55	+ 4.90	+23.88	− 2.93	+ 7.45	+23.59
+ 4.86	− 1.71	+ 6.10	− 2.93	+32.34	+ 3.11	+ 7.68
− 0.21	− 6.34	+23.93	+ 7.45	+ 3.11	+25.58	+23.75

On account of the correlation between b_0 and ε, we shall neglect b_0 in this preliminary solution. Putting therefore $b_0=0$, and solving, we derive:

$$\left.\begin{array}{r} x=-2e\delta\pi=+0.44'' \\ i\theta=\sin i\delta\Omega=-1.03 \\ \frac{1}{3}a_0=+0.54 \\ \frac{1}{3}\delta_0=+0.12 \\ \varepsilon=+0.50 \end{array}\right\}\ \text{Epoch 1720.}$$

CHAPTER IX.

EQUATIONS OF CONDITION, 1753–1908.

SECTION I.

GROUP VI—1753–1779.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1753, Apr. 19	Greenwich	β Scorpii	IB	−0.61	+0.21	−0.72	+0.30	+0.78	−0.12	−0.08	−0.64	+0.27	−2.4	−3.0
Aug. 5	Greenwich	8 Libræ	I	−0.13	−0.03	+0.97	−0.19	−0.99	+0.19	−0.04	+0.65	−0.14	−3.9	−4.0
Oct. 5	Greenwich	16 B. Capricor.	I	−0.74	+0.73	−0.03	−0.57	−0.58	−0.10	+0.16	+0.53	−0.79	+2.3	+1.6
5	Greenwich	β Capricor.	I	−0.77	+0.77	−0.03	−0.52	−0.52	−0.08	+0.16	+0.48	−0.83	+3.5	+2.7
5	Greenwich	β Capricor.	EB	+0.86	−0.85	−0.02	−0.30	−0.30	−0.07	−0.20	+0.22	+0.89	−2.5	−2.0
1754, Apr. 2	Greenwich	κ Cancri	I	−1.09	−0.90	0.00	+0.01	−0.01	−0.18	−0.22	−0.06	−0.79	−2.6	−3.7
Nov. 21	Greenwich	ρ Aquarii	I	−0.92	+0.72	+0.05	+0.04	+0.06	+0.06	+0.11	−0.11	−1.00	+2.3	+1.4
1757, Apr. 3	Greenwich	γ Virginis	IB	−0.65	+0.06	−0.53	+0.55	+0.76	−0.29	−0.16	+0.07	−0.06	+6.1	+5.5
July 30	Greenwich	19 Capricor.	IB	−1.15	−0.98	+0.13	+0.01	+0.13	−0.19	+0.16	−0.18	−0.03	+2.4	+1.4
1758, Feb. 17	Greenwich	ν Geminor.	I	−0.85	+0.54	+0.33	+0.19	−0.38	−0.01	+0.05	−0.45	−0.82	+2.3	+1.5
1761, Dec. 10	Greenwich	θ^2 Tauri	I	−0.73	+0.45	−0.09	+0.74	+0.74	0.00	+0.12	+0.64	−0.15	+1.4	+0.7
1764, Feb. 20	Greenwich	α Virginis	IB	−1.11	−0.99	+0.01	0.00	+0.01	−0.24	−0.45	−0.01	+0.74	−6.4	−7.2
20	Greenwich	α Virginis	E	+1.05	+0.94	−0.31	+0.07	−0.31	+0.35	+0.40	+0.12	−0.70	−4.9	−4.6
1765, Feb. 4	Greenwich	γ Cancri	I	−0.96	+0.45	−0.04	−0.04	−0.06	−0.04	−0.29	−0.03	−0.14	+1.2	+0.5
Sept. 25	Greenwich	δ Capricor.	I	−1.04	−0.70	−0.20	−0.06	+0.21	−0.10	+0.40	−0.11	−0.73	+0.1	−0.6
Oct. 2	Greenwich	q Tauri	IB	−0.84	+0.71	−0.07	+0.41	+0.42	+0.08	+0.23	+0.39	+0.58	−2.6	−3.2
2	Greenwich	18 Tauri	IB	−0.42	+0.35	+0.15	−0.88	−0.90	−0.21	+0.08	−0.90	+0.30	−5.7	−6.0
1766, Sept. 22	Greenwich	17 Tauri	IB	−0.51	+0.06	+0.13	+0.85	+0.86	+0.31	+0.13	+0.76	+0.37	−3.3	−3.6
22	Greenwich	20 Tauri	IB	−0.98	+0.12	+0.02	+0.15	+0.15	−0.04	+0.23	+0.18	+0.71	−0.1	−0.7
1767, Sept. 12	Greenwich	η Tauri	IB	−1.03	−0.51	+0.10	+0.19	+0.22	−0.09	+0.18	+0.26	+0.81	−3.3	−3.8
12	Greenwich	27 Tauri	IB	−0.61	−0.31	+0.39	+0.71	+0.88	+0.06	+0.10	+0.63	+0.50	−0.6	−0.9
12	Greenwich	η Tauri	E	+0.97	+0.49	+0.18	+0.33	+0.38	+0.16	+0.16	+0.25	+0.78	+1.2	+1.3
1768, Jan. 27	Greenwich	23 Tauri	I	−0.96	−0.64	−0.22	−0.31	−0.38	−0.15	+0.16	−0.32	−0.86	−0.5	−1.0
27	Greenwich	η Tauri	I	−0.24	−0.17	−0.50	−0.78	−0.97	−0.15	+0.03	−0.80	−0.22	−0.1	−0.2
27	Greenwich	η Tauri	E	+0.03	+0.01	−0.60	−0.80	−1.00	−0.13	−0.02	−0.85	+0.02	+1.1	+1.1
1769, Sept. 15	Greenwich	16 Piscium	IB	−0.86	−0.20	−0.02	−0.58	−0.58	−0.33	+0.28	+0.13	+0.02	−3.8	−4.1
20	Greenwich	67 Tauri	IB	−1.01	−0.91	−0.32	+0.15	−0.36	−0.17	+0.08	−0.25	+0.82	+0.8	+0.4
20	Greenwich	κ Tauri	IB	−0.77	−0.71	−0.68	−0.18	−0.70	−0.16	+0.06	−0.57	+0.67	+2.4	+2.1
20	Greenwich	κ Tauri	E	+0.91	+0.83	+0.52	−0.11	−0.53	+0.08	−0.08	−0.55	−0.75	+6.6	+6.6
20	Greenwich	67 Tauri	E	+1.06	+0.96	+0.16	−0.04	−0.17	+0.13	−0.08	−0.24	−0.87	+3.3	+3.3
25	Greenwich	h Leonis	IB	−0.72	−0.35	+0.36	+0.65	−0.74	+0.13	−0.29	−0.40	+0.52	+1.2	+0.9
Nov. 18	Greenwich	α Cancri	E	+0.45	+0.30	+0.52	−0.74	+0.91	−0.19	+0.18	+0.63	−0.40	+4.4	+4.4
1770, Apr. 7	Greenwich	e Leonis	I	−1.02	−0.33	+0.04	+0.16	−0.16	−0.05	−0.38	+0.08	−0.51	−0.3	−0.6
28	Greenwich	ζ Tauri	I	−1.10	−0.96	+0.02	0.00	+0.02	−0.18	−0.02	+0.10	−0.70	+1.1	+0.8
July 19	Greenwich	ζ Tauri	E	+1.10	+0.90	−0.22	+0.07	−0.23	−0.21	+0.02	−0.30	−0.54	+2.2	+2.0
1771, July 4	Greenwich	δ Piscium	IB	−0.81	+0.56	−0.40	−0.27	−0.48	−0.13	+0.25	−0.05	+0.85	−2.7	−2.9
4	Greenwich	δ Piscium	E	+0.86	−0.61	−0.31	−0.20	−0.37	−0.13	−0.32	−0.11	−0.91	+2.0	+1.8
Sept. 18	Greenwich	β Capricor.	I	−0.69	−0.60	+0.10	−0.65	−0.66	−0.14	+0.15	+0.67	−0.62	+3.4	+3.3
Dec. 24	Greenwich	κ Cancri	E	+1.10	+0.86	0.00	+0.01	−0.01	+0.18	+0.26	−0.06	−0.65	+2.2	+1.9
1772, May 15	Greenwich	8 Libræ	I	−1.00	−0.71	+0.43	−0.11	−0.44	−0.07	−0.20	+0.35	−0.21	+0.5	+0.4
15	Greenwich	α Libræ	I	−1.05	−0.75	+0.32	−0.08	−0.33	−0.10	−0.21	+0.28	−0.21	+1.3	+1.2
Aug. 17	Greenwich	ζ Piscium	E	+0.74	−0.83	−0.56	−0.06	−0.57	−0.20	−0.25	−0.20	−0.64	+2.4	+2.1
Sept. 7	Greenwich	β Capricor.	I	−0.74	+0.15	−0.11	−0.62	−0.63	−0.14	+0.14	+0.54	−0.59	−3.5	−3.6
1773, Feb. 6	Greenwich	α Cancri	I	−1.02	−0.21	−0.10	−0.21	+0.24	−0.18	−0.21	+0.22	−0.05	−0.2	−0.2
Sept. 7	Greenwich	α Tauri	IB	−0.62	+0.66	+0.31	−0.66	+0.73	+0.10	+0.09	+0.69	+0.68	−0.3	−0.3
Nov. 1	Greenwich	α Tauri	IB	−0.82	+0.90	+0.16	−0.37	+0.40	+0.07	+0.12	+0.38	+0.40	+1.1	+1.1
1774, Nov. 18	Greenwich	α Tauri	E	+0.92	−0.77	0.00	+0.11	+0.11	−0.01	−0.16	−0.07	−0.07	−2.1	−2.6
1775, Aug. 1	Greenwich	γ Virginis	EB	+0.83	−0.42	+0.33	−0.30	−0.44	+0.12	+0.27	+0.09	+0.81	−3.6	−4.0
Dec. 12	Greenwich	α Leonis	E	+0.76	−0.84	+0.53	−0.07	−0.54	+0.07	+0.17	−0.24	−0.75	−3.0	−3.5
1776, Jan. 29	Greenwich	α Tauri	I	−0.97	−0.04	−0.02	−0.06	+0.07	−0.05	+0.19	0.00	−0.93	+3.1	+3.3
Mar. 30	Greenwich	α Leonis	I	−0.81	+0.88	+0.41	−0.10	−0.42	+0.15	−0.23	−0.26	−0.62	+2.4	+2.6
Apr. 6	Greenwich	γ Libræ	IB	−0.49	+0.11	−0.14	−0.85	−0.86	+0.19	−0.16	+0.66	+0.34	−2.3	−2.2
1777, Nov. 16	Greenwich	ζ Tauri	IB	−1.12	−0.86	−0.08	−0.03	+0.09	−0.20	+0.14	0.00	+0.33	−0.5	−0.3
16	Greenwich	ζ Tauri	E	+1.08	+0.83	−0.28	−0.10	+0.30	+0.24	−0.13	+0.37	−0.32	+1.9	+1.3
1778, Feb. 7	Greenwich	μ Geminor.	I	−0.75	−0.57	+0.71	+0.05	−0.71	−0.16	+0.05	−0.78	−0.50	−0.3	−0.1
Dec. 31	Greenwich	ι Tauri	I	−0.97	−0.84	+0.49	+0.06	−0.49	−0.26	+0.17	−0.56	−0.36	+1.3	+1.5
1779, Feb. 27	Greenwich	γ Cancri	I	−1.08	−0.88	+0.14	−0.16	−0.21	−0.13	−0.16	−0.26	−0.55	+2.0	+2.2
Oct. 30	Greenwich	1 Geminor.	E	+0.88	+0.80	−0.38	+0.42	+0.57	+0.08	+0.07	+0.62	−0.80	+0.2	−0.3
Dec. 22	Greenwich	132 Tauri	I	−0.77	−0.51	−0.66	+0.28	+0.72	−0.06	+0.08	+0.66	−0.06	+0.5	+0.7

GROUP VII—1783–1801.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1783, Feb. 9	Greenwich	q Tauri	I	−0.61	−0.61	+0.43	−0.60	−0.74	−0.20	+0.16	−0.64	−0.66	+1.1	+1.2
9	Greenwich	18 Tauri	I	−0.58	−0.58	+0.45	−0.62	−0.77	−0.19	+0.14	−0.66	−0.63	−1.6	−1.5
May 16	Greenwich	π Scorpii	IB	−1.14	−0.89	+0.02	+0.04	−0.05	−0.22	−0.26	+0.05	+0.15	+0.6	+0.7
Oct. 7	Greenwich	φ Aquarii	I	−0.72	−0.38	−0.73	−0.03	+0.73	+0.20	+0.39	−0.31	−0.38	−2.4	−2.3
Dec 6	Greenwich	17 Tauri	I	−0.83	+0.46	−0.14	+0.45	+0.47	+0.08	+0.09	+0.41	−0.35	+0.6	+0.7
6	Greenwich	q Tauri	I	−0.25	+0.14	+0.28	−0.92	−0.96	−0.18	+0.03	−0.80	−0.09	−3.1	−3.1
30	Greenwich	δ Piscium	I	−0.87	−0.30	+0.43	−0.24	−0.49	−0.32	+0.46	−0.09	−0.88	+1.6	+1.7
30	Greenwich	δ Piscium	EB	+0.95	+0.33	+0.26	−0.15	−0.30	−0.03	−0.46	−0.09	+0.96	−4.6	−5.1
1784, July 2	Greenwich	τ Sagittarii	IB	−0.90	+0.68	−0.39	−0.48	+0.62	−0.10	+0.12	−0.57	+0.04	−1.8	−1.7
1785, Apr. 11	Greenwich	q Tauri	I	−1.05	−0.41	−0.03	−0.20	−0.20	−0.19	+0.20	−0.12	−0.50	+0.6	+0.6
11	Greenwich	17 Tauri	I	−0.12	−0.05	+0.16	+0.98	+0.99	+0.19	+0.04	+0.84	−0.07	+0.5	+0.5
11	Greenwich	20 Tauri	I	−1.05	−0.41	+0.04	+0.22	+0.22	−0.11	+0.20	+0.24	−0.50	−2.0	−2.0
11	Greenwich	21 Tauri	I	−0.94	−0.37	−0.08	−0.47	−0.48	−0.23	+0.18	−0.43	−0.44	+0.8	+0.8
11	Greenwich	22 Tauri	I	−1.00	−0.39	−0.06	−0.36	−0.36	−0.21	+0.19	−0.34	−0.47	+0.2	+0.2
June 22	Greenwich	φ Sagittarii	IB	−1.04	−0.29	+0.07	+0.05	−0.09	−0.14	+0.12	+0.14	−0.16	−2.2	−2.2
Aug. 16	Greenwich	φ Sagittarii	EB	+1.02	+0.43	+0.17	+0.11	−0.20	+0.10	−0.14	+0.13	+0.66	−4.2	−4.6
1786, Mar. 5	Greenwich	17 Tauri	I	−1.00	−0.80	+0.17	+0.35	+0.39	−0.08	+0.18	+0.40	−0.84	−1.3	−1.3
5	Greenwich	16 Tauri	I	−1.04	−0.84	−0.11	−0.23	−0.26	−0.19	+0.18	−0.15	−0.90	−1.2	−1.2
5	Greenwich	q Tauri	I	−0.56	−0.45	−0.38	−0.77	−0.86	−0.24	+0.08	−0.69	−0.50	+1.6	+1.6
5	Greenwich	20 Tauri	I	−0.99	−0.79	−0.18	−0.36	−0.40	−0.21	+0.15	−0.27	−0.84	−0.3	−0.3
Nov. 12	Greenwich	π Leonis	IB	−0.92	−0.05	+0.26	−0.21	+0.34	−0.20	−0.34	+0.27	+0.94	−8.4	−8.4
12	Greenwich	π Leonis	E	+0.97	+0.05	+0.04	−0.03	+0.05	+0.05	+0.39	−0.05	−1.00	+3.2	+2.9
Dec. 9	Greenwich	ξ Leonis	IB	−0.58	−0.14	−0.70	+0.44	−0.82	+0.22	−0.26	−0.48	+0.44	−4.5	−4.5
9	Greenwich	ξ Leonis	E	+0.62	+0.14	−0.67	+0.42	−0.79	+0.35	+0.16	−0.56	−0.47	+2.5	+2.3
1787, Nov. 26	Greenwich	η Geminor.	IB	−1.14	−1.00	+0.06	0.00	+0.07	−0.23	−0.09	+0.16	+0.36	−3.4	−3.5
26	Greenwich	η Geminor.	E	+1.13	+0.99	+0.13	−0.01	+0.13	+0.21	+0.08	+0.04	−0.36	+2.9	+2.7
26	Greenwich	μ Geminor.	IB	−0.35	−0.31	−0.95	+0.09	−0.95	+0.03	−0.04	−0.39	+0.13	−0.4	−0.4
26	Greenwich	μ Geminor.	E	+0.15	+0.14	−0.99	+0.10	−0.99	+0.11	+0.01	−1.00	−0.07	−0.5	−0.5
1788, Oct. 18	Greenwich	ι Tauri	IB	−0.96	−0.56	+0.38	−0.02	+0.38	−0.10	+0.01	+0.41	+0.70	−4.3	−4.5
18	Greenwich	ι Tauri	E	+0.86	+0.50	+0.56	−0.04	+0.56	+0.10	−0.01	+0.68	−0.62	+0.7	+0.6
Nov. 15	Greenwich	ζ Tauri	IB	−0.63	−0.39	+0.79	−0.18	+0.81	−0.11	−0.02	+0.85	+0.31	−4.2	−4.3
15	Greenwich	ζ Tauri	E	+0.46	+0.28	+0.88	−0.21	+0.91	+0.05	+0.02	+0.87	−0.21	−0.7	−0.7
1789, Nov. 9	Greenwich	κ Cancri	E	+0.69	+0.53	−0.09	+0.75	−0.76	+0.29	+0.15	−0.59	−0.65	+0.1	+0.1
1790, Mar. 5	Greenwich	κ Libræ	I	−0.60	−0.41	−0.81	+0.16	+0.83	−0.19	−0.07	−0.64	+0.53	−3.0	−3.3
Aug. 17	Greenwich	ν Scorpii	I	−0.69	−0.55	+0.67	−0.35	−0.76	0.00	−0.08	+0.71	−0.65	−1.1	−1.4
Oct. 15	Greenwich	β Capricor.	I	−0.67	−0.08	0.00	−0.73	−0.73	−0.18	+0.13	+0.65	−0.67	+2.5	+2.2
Nov. 17	Greenwich	ε Piscium	I	−0.85	+0.88	−0.30	−0.08	−0.31	−0.04	+0.28	−0.08	−0.68	+1.4	+1.0
1791, Mar. 16	Greenwich	κ Cancri	I	−1.01	−0.04	+0.04	+0.11	−0.12	−0.07	−0.24	−0.04	−0.55	−0.1	−0.7
Apr. 7	Greenwich	δ Tauri	I	−0.84	+0.89	−0.26	+0.24	−0.35	0.00	+0.09	−0.14	−0.70	+1.5	+1.0
June 12	Greenwich	λ Virginis	I	−0.84	−0.72	+0.63	−0.17	−0.65	+0.03	−0.21	+0.41	−0.52	−1.3	−1.8
12	Greenwich	λ Virginis	I	−0.82	−0.70	+0.65	−0.18	−0.67	+0.03	−0.20	+0.42	−0.51	−0.7	−1.2
1792, Mar. 27	Greenwich	α Tauri	I	−0.56	+0.56	+0.35	−0.71	+0.79	+0.09	+0.07	+0.74	−0.55	+0.3	−0.1
1793, Apr. 19	Camb., Eng.	ξ Leonis	I	−0.43	+0.49	−0.80	−0.36	+0.88	−0.16	−0.08	+0.56	−0.42	+3.0	+2.6
19	Greenwich	ξ Leonis	I	−0.40	+0.45	−0.82	−0.36	+0.90	−0.17	−0.08	+0.53	−0.38	+2.1	+1.7
1794, Mar. 5	Camb., Eng.	μ Ceti	I	−1.08	−0.71	−0.02	+0.06	−0.06	+0.22	+0.28	−0.02	−0.75	+2.3	+1.2
5	Greenwich	μ Ceti	I	−1.08	−0.70	+0.03	−0.09	+0.10	−0.11	+0.30	0.00	−0.74	+6.9	+5.8
7	Camb., Eng.	α Tauri	I	−0.50	−0.16	+0.17	+0.86	−0.87	−0.23	+0.08	−0.84	−0.48	0.0	−0.5
Aug. 4	Greenwich	γ Libræ	I	−0.94	+0.62	−0.03	−0.03	−0.03	−0.01	−0.25	−0.01	−0.97	+2.0	+1.1
Nov. 8	Camb., Eng.	α Tauri	IB	−1.10	−0.70	−0.07	+0.17	+0.19	−0.17	+0.19	+0.12	+0.21	+2.4	+1.3
8	Camb., Eng.	α Tauri	E	+1.02	+0.65	+0.16	+0.37	−0.41	+0.12	−0.18	−0.31	−0.20	−1.2	−0.4
8	Greenwich	α Tauri	E	+1.04	+0.66	−0.14	−0.33	+0.36	+0.25	−0.17	+0.39	−0.20	−6.2	−5.4
Dec. 18	Greenwich	γ Libræ	E	+0.91	−0.82	−0.03	−0.16	−0.16	+0.05	+0.25	+0.10	−0.54	−2.1	−1.4
18	Camb., Eng.	γ Libræ	E	+0.91	−0.81	−0.04	+0.19	−0.19	+0.05	+0.25	−0.13	−0.53	−0.6	+0.1
1795, Aug. 6	Greenwich	ξ^2 Ceti	IB	−0.31	−0.28	+0.77	−0.95	−0.96	−0.36	+0.04	−0.59	+0.29	−1.5	−1.9
Oct. 6	Greenwich	δ Cancri	E	+0.84	+0.34	−0.53	+0.10	+0.54	−0.02	+0.12	+0.49	−0.81	0.0	+0.7
6	Camb., Eng.	δ Cancri	E	+0.86	+0.35	−0.51	+0.09	+0.52	−0.01	+0.13	+0.47	−0.88	−1.2	−0.4
Nov. 24	Greenwich	μ Ceti	I	−1.04	−0.86	+0.12	+0.42	−0.44	−0.34	+0.27	−0.36	−0.37	−0.4	−1.6
1797, Mar. 17	Camb., Eng.	ν Scorpii	E	+0.70	−0.41	−0.61	−0.29	−0.67	+0.20	+0.18	+0.66	−0.65	−2.0	−1.3
Dec. 25	Camb., Eng.	33 Piscium	I	−0.81	+0.72	−0.11	−0.44	−0.45	−0.18	+0.33	−0.07	−0.89	+3.4	+2.3
25	Greenwich	33 Piscium	I	−0.82	+0.73	+0.11	+0.43	−0.44	−0.18	+0.33	−0.07	−0.90	+3.2	+2.1
1798, Aug. 8	Greenwich	ε Geminor.	E	+0.99	+0.39	−0.29	+0.22	+0.36	+0.13	−0.02	+0.43	−0.51	−0.7	+0.5
Oct. 5	Camb., Eng.	η Leonis	IB	−0.90	−0.72	+0.03	−0.59	−0.59	+0.03	−0.30	−0.36	+0.57	−3.0	−4.3
1799, Apr. 10	Camb., Eng.	125 Tauri	I	−0.94	+0.28	−0.04	+0.03	+0.05	−0.02	+0.12	−0.02	−0.94	+3.2	+1.7
10	Greenwich	125 Tauri	I	−0.94	+0.28	−0.10	+0.07	+0.12	−0.02	+0.12	+0.05	−0.94	+3.2	+1.7
21	Greenwich	δ Scorpii	E	+1.10	+0.77	−0.18	+0.04	−0.19	+0.27	+0.28	+0.22	−0.40	+1.3	+2.6
1800, May 5	Greenwich	η Virginis	I	−0.73	−0.42	+0.69	+0.32	+0.76	−0.47	−0.23	−0.05	−0.40	+3.1	+1.9
July 4	Greenwich	43 Ophiuchi	I	−0.90	−0.77	−0.35	+0.50	−0.61	−0.11	−0.10	+0.57	−0.30	+2.6	+1.1
Sept. 30	Camb., Eng.	ψ Aquarii	I	−0.77	−0.11	−0.52	−0.37	+0.64	+0.19	+0.41	−0.22	−0.40	+3.3	+2.0
Nov. 26	Camb., Eng.	ζ Piscium	I	−0.55	+0.19	+0.81	−0.03	−0.81	−0.39	+0.18	−0.26	−0.48	+1.8	+0.9
26	Greenwich	ζ Piscium	I	−0.60	+0.21	+0.77	−0.03	−0.77	−0.39	+0.20	−0.21	−0.51	+1.6	+0.6

GROUP VII—1783–1801—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1800, Nov. 26	Greenwich	ζ Pisc.(comp.)	I	−0.60	+0.21	+0.77	−0.03	−0.77	−0.39	+0.20	−0.21	−0.51	+1.6	+0.6
1801, Jan. 5	Greenwich	β Virginis	IB	−0.65	−0.05	+0.70	+0.25	+0.74	−0.39	−0.23	+0.06	+0.64	+1.1	0.0
5	Greenwich	β Virginis	E	+0.85	+0.06	+0.48	+0.17	+0.51	−0.16	+0.45	+0.05	−0.83	−1.2	−0.1
Mar. 30	Camb., Eng.	α Virginis	IB	−0.97	−0.31	+0.35	−0.07	+0.36	−0.31	−0.38	−0.14	+0.25	−2.0	−3.6
30	Greenwich	α Virginis	IB	−0.96	−0.31	+0.37	−0.07	+0.38	−0.31	−0.39	−0.14	+0.25	+2.2	+0.6
30	Greenwich	α Virginis	E	+1.03	+0.33	+0.13	−0.03	+0.14	+0.09	+0.47	−0.05	−0.28	+0.8	+2.2
30	Camb., Eng.	α Virginis	E	+1.03	+0.33	+0.12	−0.03	+0.13	+0.10	+0.46	−0.04	−0.28	−0.2	+1.2
Apr. 24	Greenwich	σ Leonis	I	−0.85	+0.26	−0.45	−0.19	−0.48	+0.15	−0.44	−0.13	−0.61	+1.6	+0.2
May 21	Camb., Eng.	χ Leonis	I	−0.77	+0.33	+0.54	+0.25	+0.59	−0.32	−0.30	+0.42	−0.76	+3.1	+1.8
24	Greenwich	α Virginis	I	−0.94	−0.24	+0.41	−0.10	+0.42	−0.33	−0.37	−0.16	−0.51	+2.6	+1.0
24	Camb., Eng.	α Virginis	I	−0.95	−0.24	+0.39	−0.10	+0.40	−0.33	−0.37	−0.15	−0.51	+2.7	+1.1
24	Camb., Eng.	α Virginis	EB	+1.04	+0.27	+0.10	−0.03	+0.10	+0.12	+0.47	−0.04	+0.55	−3.6	−2.2

GROUP VIII—1801–1820.

1801, Oct. 23	Camb., Eng.	η Tauri	IB	−0.82	+0.33	+0.28	−0.46	−0.53	−0.18	+0.20	−0.45	+0.28	−0.5	−1.9
23	Greenwich	24 Tauri	IB	−0.79	+0.32	+0.30	−0.50	−0.59	−0.20	−0.19	−0.54	+0.27	−2.0	−3.3
23	Greenwich	η Tauri	IB	−0.84	+0.34	+0.26	−0.43	−0.51	−0.17	+0.21	−0.44	+0.29	+1.9	+0.5
23	Greenwich	23 Tauri	E	+0.97	−0.39	+0.04	−0.07	−0.08	+0.05	−0.26	−0.06	−0.33	−1.0	+0.3
23	Greenwich	27 Tauri	IB	−0.94	+0.38	−0.13	+0.22	+0.26	0.00	+0.26	+0.22	+0.32	−0.6	−2.2
23	Greenwich	28 Tauri	IB	−0.97	+0.39	−0.02	+0.03	+0.04	−0.07	+0.25	−0.06	+0.33	−1.0	−2.6
23	Camb., Eng.	η Tauri	E	+0.93	−0.37	+0.15	−0.25	−0.29	−0.01	−0.25	−0.24	−0.32	−1.4	−0.1
23	Camb., Eng.	27 Tauri	E	+0.88	−0.35	−0.21	+0.37	+0.43	+0.16	−0.22	+0.36	−0.30	−1.3	0.0
23	Camb., Eng.	28 Tauri	E	+0.96	−0.38	+0.07	+0.12	+0.14	+0.09	−0.24	+0.11	−0.33	−5.0	−3.6
23	Greenwich	27 Tauri	E	+0.86	−0.34	−0.23	+0.40	+0.46	+0.16	−0.20	+0.39	−0.29	−2.4	−1.2
23	Greenwich	28 Tauri	E	+0.95	−0.38	−0.09	+0.15	+0.17	+0.09	−0.25	+0.15	−0.32	−4.4	−3.1
1802, Mar. 14	Greenwich	γ Cancri	I	−0.89	+0.97	+0.08	+0.08	+0.11	−0.03	−0.28	+0.11	−0.73	+2.9	+1.3
Nov. 3	Greenwich	γ Capricor.	EB	+0.73	+0.65	−0.69	+0.24	−0.73	−0.14	−0.31	+0.45	+0.66	−9.0	−8.0
3	Greenwich	δ Capricor.	I	−0.89	−0.79	−0.53	−0.17	+0.56	+0.05	+0.37	−0.33	−0.82	+2.7	+1.1
1803, Mar. 3	Greenwich	κ Geminor.	I	−0.88	+0.32	+0.25	+0.22	+0.33	−0.08	−0.19	+0.34	−0.77	+3.7	+2.1
1804, July 17	Greenwich	π Scorpii	I	−0.52	+0.53	+0.34	+0.74	−0.81	+0.14	−0.12	+0.77	−0.42	+0.2	−0.7
Dec. 14	Greenwich	η Tauri	I	−1.08	−0.93	−0.17	−0.30	−0.35	−0.36	+0.16	−0.22	−0.40	−0.2	−2.1
14	Greenwich	27 Tauri	I	−1.15	−0.99	−0.03	−0.05	−0.05	−0.23	+0.16	−0.22	−0.40	−0.8	−2.9
14	Greenwich	28 Tauri	I	−1.07	−0.92	−0.18	−0.31	−0.36	−0.25	+0.16	+0.04	−0.38	−0.1	−2.0
1805, Aug. 6	Greenwich	λ Sagittarii	I	−0.87	+0.97	−0.25	−0.05	+0.25	+0.04	+0.12	−0.17	−0.65	+1.6	0.0
Sept. 7	Greenwich	θ Aquarii	I	−0.94	+0.52	−0.11	+0.12	+0.16	+0.01	+0.40	−0.05	−0.20	−2.0	−3.7
7	Greenwich	θ Aquarii	EB	+0.90	−0.50	−0.23	+0.25	+0.34	+0.19	−3.36	−0.39	+0.18	−3.0	−1.7
1807, Dec. 14	Greenwich	ζ Tauri	IB	−0.66	+0.14	−0.69	+0.29	−0.74	−0.03	−0.01	−0.69	+0.02	−0.6	−1.8
14	Greenwich	ζ Tauri	E	+0.88	−0.19	−0.41	+0.17	−0.44	+0.07	+0.03	−0.51	−0.06	−3.1	−1.9
1808, Apr. 5	Havana	60 Cancri	I	−0.97	−0.42	−0.08	+0.36	−0.37	−0.02	−0.29	−0.20	−0.77	−0.2	−1.9
May 3	Havana	ω Leonis	I	−0.43	−0.24	−0.04	+0.91	−0.91	+0.21	−0.17	−0.57	−0.40	+6.9	+6.1
Oct. 31	Greenwich	δ Piscium	I	−0.97	−0.69	−0.42	−0.26	−0.49	−0.12	+0.24	−0.06	−0.43	+2.5	+1.1
1809, Feb. 27	Greenwich	60 Cancri	I	−0.92	+0.21	+0.02	+0.34	−0.34	+0.05	−0.25	−0.28	+0.34	+0.3	−1.4
Apr. 3	Greenwich	γ Scorpii	IB	−1.10	−0.99	+0.13	−0.07	−0.15	−0.16	−0.12	+0.19	−0.72	−6.2	−8.3
29	Havana	8 Libræ	IB	−1.09	−0.88	−0.31	−0.05	−0.31	−0.14	−0.20	+0.27	+0.09	−0.6	−2.7
29	Havana	α Libræ	IB	−1.12	−0.91	+0.21	−0.03	−0.22	−0.16	−0.19	+0.21	+0.10	−2.2	−4.3
29	Havana	α Libræ	E	+1.00	+0.82	+0.48	−0.08	−0.49	+0.27	+0.18	+0.28	−0.08	−4.1	−2.6
June 23	Havana	8 Libræ	I	−1.10	−0.90	−0.12	+0.02	+0.12	−0.19	−0.21	−0.02	−0.69	+1.0	−1.1
23	Havana	α Libræ	I	−0.88	−0.89	−0.21	+0.04	+0.21	−0.01	−0.20	−0.08	−6.69	+2.2	+0.5
28	Havana	β Capricor.	IB	−1.11	−0.70	0.00	−0.13	−0.13	−0.22	+0.20	+0.13	+0.32	−0.5	−2.6
28	Havana	β Capricor.	E	+1.08	+0.69	+0.01	+0.26	+0.26	+0.24	−0.19	−0.26	−0.31	−3.3	−1.7
Sept. 28	Greenwich	64 Tauri	E	+0.90	−0.95	−0.07	+0.07	−0.09	+0.04	−0.11	−0.11	−0.84	+0.8	+2.1
Nov. 12	Havana	β Capricor.	I	−1.08	−0.87	0.00	−0.03	−0.03	−0.17	+0.19	+0.06	−0.91	+1.3	−0.8
12	Havana	β Capricor.	EB	+1.02	+0.83	+0.05	+0.30	+0.31	+0.19	−0.17	−0.29	+0.86	−1.7	−0.2
Dec. 15	Greenwich	ζ Piscium	I	−0.79	+0.14	+0.54	−0.03	+0.55	+0.16	+0.27	+0.18	−0.80	−0.8	−2.3
1810, Jan. 15	Greenwich	δ Tauri	I	−0.77	+0.72	−0.36	+0.37	−0.52	−0.02	+0.08	−0.43	−0.68	+2.3	+0.8
15	Paris	δ Tauri	I	−0.82	+0.76	−0.29	+0.30	−0.42	−0.01	+0.10	−0.35	−0.72	+2.0	+0.4
15	Paris	64 Tauri	I	−0.90	+0.84	0.00	0.00	0.00	+0.03	+0.11	+0.03	−0.79	+2.7	+1.0
15	Greenwich	64 Tauri	I	−0.90	+0.84	−0.06	+0.06	−0.09	+0.02	+0.10	−0.05	−0.79	+1.6	−0.1
Feb. 18	Havana	π Leonis	IB	−0.93	+0.61	+0.08	+0.10	−0.13	+0.04	−0.26	−0.06	0.00	−0.3	−2.1
May 10	Paris	60 Cancri	I	−0.73	+0.72	−0.27	−0.52	+0.58	−0.09	−0.15	+0.47	−0.81	+2.5	+1.1
June 15	Paris	χ Ophiuchi	I	−0.97	−0.65	+0.29	−0.41	−0.50	−0.11	−0.11	+0.47	−0.20	+0.5	−1.3
July 25	Paris	63 Tauri	IB	−0.65	+0.38	−0.41	−0.58	−0.71	−0.07	+0.08	−0.62	+0.63	−2.0	−3.2
25	Paris	63 Tauri	E	+0.76	−0.44	−0.32	+0.46	−0.57	−0.08	−0.12	−0.52	−0.73	+0.2	+1.4
Sept. 18	Paris	α Tauri	IB	−0.91	+0.46	+0.15	−0.26	+0.30	0.00	+0.10	+0.29	+0.84	−1.0	−2.7
18	Paris	α Tauri	E	+0.85	−0.43	+0.22	−0.39	+0.45	−0.07	−0.10	+0.41	−0.80	+0.8	+2.1
1811, Mar. 1	Paris	275 B. Tauri	I	−0.80	+0.14	+0.19	−0.52	+0.55	+0.05	+0.11	+0.51	−0.83	+2.6	+1.1
1	Paris	α Tauri	I	−0.96	+0.17	+0.02	−0.07	+0.07	−0.03	+0.12	+0.07	−1.00	+1.9	+0.1
1	Greenwich	α Tauri	I	−0.96	+0.17	−0.02	+0.07	−0.07	−0.05	+0.12	−0.06	−1.00	+2.3	+0.5
1	Camb., Eng.	α Tauri	I	−0.96	+0.17	−0.04	+0.10	−0.11	−0.06	+0.12	−0.10	−0.99	+2.6	+0.8

GROUP VIII—1801-1820—Continued.

Date.	Place	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													"	"
1811, Mar. 1	Camb., Eng.	α Tauri	EB	+0.95	−0.17	−0.05	+0.15	−0.16	+0.02	−0.12	−0.15	+0.99	−2.5	−1.1
1	Paris	α Tauri	EB	+0.96	−0.17	0.00	0.09	0.00	+0.04	−0.11	0.00	+1.00	−2.8	−1.4
1	Greenwich	α Tauri	EB	+0.96	−0.17	−0.04	+0.11	−0.12	+0.03	−0.12	−0.11	+0.99	−4.3	−2.9
7	Paris	ο Leonis	I	−0.56	+0.62	−0.70	−0.34	+0.78	−0.16	−0.12	+0.48	−0.24	+1.0	−0.1
July 15	Havana	α Tauri	IB	−0.73	−0.05	+0.16	−0.65	+0.67	+0.04	+0.11	+0.61	+0.58	−0.3	−1.7
26	Havana	θ Virginis	I	−0.90	+0.70	−0.12	+0.06	+0.14	0.00	−0.28	−0.07	−0.99	+0.9	−0.8
Aug. 26	Paris	49 Libræ	I	−0.84	+0.04	−0.16	+0.47	+0.50	−0.12	−0.14	−0.44	−0.86	+1.6	0.0
Sept. 2	Paris	λ Aquarii	I	−0.68	−0.59	+0.80	+0.12	+0.81	+0.11	+0.21	−0.31	−0.03	−3.3	−4.6
2	Paris	λ Aquarii	EB	+0.56	+0.49	+0.86	+0.13	+0.88	+0.35	−0.11	−0.30	+0.02	−1.7	−0.9
2	Paris	78 Aquarii	I	−1.14	−0.99	+0.15	+0.02	+0.15	−0.16	+0.28	−0.08	−0.05	+2.1	−0.1
2	Paris	78 Aquarii	EB	+1.09	+0.95	+0.32	+0.04	+0.32	+0.29	−0.26	−0.08	−0.05	−2.0	−0.4
Oct. 23	Paris	187 B. Sagittarii	I	−1.05	−0.53	−0.09	−0.16	−0.15	−0.13	+0.06	+0.12	−0.95	+6.3	+4.3
23	Havana	45 Sagittarii	I	−0.87	−0.45	+0.29	+0.45	+0.54	−0.05	+0.08	−0.53	−0.82	+2.0	+0.3
27	Camb., Eng.	λ Aquarii	I	−0.92	−0.91	+0.39	+0.04	+0.39	+0.07	+0.28	−0.17	−0.72	−4.2	−5.9
1812, Jan. 23	Paris	α Tauri	I	−0.30	−0.12	−0.05	+0.95	−0.95	−0.17	+0.03	−0.90	−0.24	−2.2	−2.8
23	Paris	α Tauri	EB	+0.47	+0.19	−0.04	+0.89	−0.89	−0.08	−0.08	−0.82	+0.37	−3.1	−2.4
May 24	Havana	ν Libræ	I	−0.84	+0.61	+0.08	−0.44	−0.44	+0.08	−0.21	+0.32	−0.08	+5.6	+4.0
Aug. 28	Havana	α Tauri	IB	−0.81	−0.60	+0.08	+0.63	−0.63	−0.20	+0.13	−0.62	+0.78	+0.7	−0.8
28	Havana	α Tauri	E	+0.99	+0.72	+0.05	+0.35	−0.35	+0.08	−0.17	−0.29	−0.93	−1.7	−0.2
Oct. 19	Havana	ν Piscium	I	−1.10	−0.95	−0.18	+0.28	−0.33	−0.32	+0.29	−0.19	+0.08	+0.2	−1.9
19	Paris	ν Piscium	I	−1.16	−1.00	0.00	0.00	0.00	−0.21	+0.31	−0.06	−0.08	−0.1	−2.3
21	Paris	f Tauri	E	+0.90	+0.73	+0.05	−0.62	+0.63	+0.31	−0.16	+0.50	−0.20	−0.1	+1.2
21	Dorpat	f Tauri	IB	−1.00	−0.81	+0.04	−0.49	+0.49	−0.09	+0.22	+0.34	+0.24	−4.7	−6.6
21	Dorpat	f Tauri	E	+0.90	+0.73	+0.05	−0.63	+0.63	+0.31	−0.16	+0.52	−0.22	−1.0	+0.4
Nov. 24	Havana	α Leonis	IB	−0.22	+0.08	+0.97	−0.04	+0.97	+0.22	−0.08	−0.52	+0.22	−1.0	−1.4
24	Havana	α Leonis	E	+0.37	−0.13	+0.92	−0.04	+0.92	+0.21	+0.07	−0.47	−0.38	−0.1	+0.5
Dec. 10	Havana	85 Aquarii	I	−0.92	−0.64	−0.43	+0.15	−0.45	−0.21	+0.25	+0.08	−0.89	+4.7	+3.0
10	Havana	87 Aquarii	I	−0.80	−0.55	−0.60	+0.22	−0.64	−0.26	+0.20	+0.15	−0.77	+5.3	+3.8
14	Greenwich	μ Ceti	I	−0.85	−0.95	+0.06	−0.28	+0.29	+0.11	+0.29	+0.12	−0.65	+4.6	+3.0
16	Dorpat	γ Tauri	I	−1.00	−0.77	+0.08	+0.46	−0.46	−0.26	+0.25	−0.46	−0.34	−0.9	−2.8
16	Dorpat	γ Tauri	EB	+1.06	+0.82	+0.06	+0.28	−0.34	+0.13	−0.18	−0.26	+0.37	−9.9	−8.3
16	Dorpat	θ² Tauri	I	−0.82	+0.64	−0.15	−0.67	+0.68	+0.02	+0.14	+0.64	−0.29	−1.8	−3.4
16	Dorpat	264 B. Tauri	I	−1.13	−0.87	+0.01	+0.05	−0.05	−0.20	+0.19	−0.10	−0.39	+2.5	+0.4
16	Dorpat	α Tauri	I	−1.11	−0.88	+0.03	+0.16	−0.16	−0.23	+0.17	−0.19	−0.39	−0.3	−2.5
1813, Mar. 6	Greenwich	μ Ceti	I	−1.04	−0.93	−0.05	+0.35	−0.35	−0.28	+0.26	−0.30	−0.74	+0.1	−1.9
6	Paris	μ Ceti	I	−1.08	−0.97	−0.03	+0.22	−0.22	−0.24	+0.27	−0.21	−0.87	+0.2	−1.9
6	Camb., Eng.	μ Ceti	I	−1.02	−0.92	−0.06	+0.39	−0.40	−0.28	+0.25	−0.31	−0.73	+2.4	+0.5
8	Camb., Eng.	α Tauri	I	−1.04	−0.90	+0.08	+0.25	−0.26	−0.16	+0.07	−0.19	−0.95	+2.5	+0.5
Apr. 8	Dorpat	ζ Cancri	I	−1.00	−0.41	+0.05	+0.02	−0.05	−0.06	−0.10	−0.10	−1.00	+5.1	+3.2
8	Dorpat	ζ Cancri	I	−1.00	−0.41	+0.05	+0.02	−0.05	−0.06	−0.10	−0.10	−1.00	+6.8	+4.9
8	Dorpat	ζ Cancri	EB	+1.00	+0.40	+0.17	+0.05	−0.18	+0.10	+0.11	−0.10	+0.98	−0.8	+0.7
10	Dorpat	ν Leonis	I	−0.95	+0.04	+0.13	−0.02	−0.13	+0.01	−0.24	−0.12	−0.83	+3.5	+1.7
10	Dorpat	ν Leonis	EB	+0.93	−0.04	+0.25	−0.04	−0.25	+0.08	+0.23	−0.09	+0.81	−8.8	−7.4
17	Greenwich	γ Libræ	IB	−0.89	+0.97	−0.02	−0.17	−0.17	+0.06	−0.26	+0.08	+0.40	−0.1	−1.8
17	Greenwich	γ Libræ	E	+0.82	−0.90	−0.04	−0.42	−0.42	+0.08	+0.21	+0.38	−0.37	−2.2	−1.0
July 11	Camb., Eng.	μ Sagittarii	I	−0.79	+0.68	+0.39	+0.34	+0.52	−0.04	−0.04	−0.57	−0.24	+1.0	−0.5
12	Paris	π Sagittarii	I	−0.90	+0.58	+0.26	+0.14	+0.30	0.00	+0.01	−0.37	−0.06	+3.6	+1.9
Aug. 13	Greenwich	ψ¹ Aquarii	E	+0.56	+0.18	+0.70	−0.47	+0.84	−0.26	−0.13	−0.19	−0.23	−2.2	−1.4
Sept. 14	Greenwich	27 Tauri	E	+1.01	+0.89	−0.09	−0.39	+0.40	+0.26	−0.23	+0.31	−0.76	−0.9	+0.6
Nov. 29	Camb., Eng.	δ Capricor.	I	−0.75	+0.17	+0.59	−0.18	+0.61	+0.12	+0.20	−0.45	−0.79	+3.0	+1.6
Dec. 28	Paris	ψ¹ Aquarii	I	−0.83	−0.08	−0.39	+0.35	−0.53	−0.20	+0.24	−0.06	−0.81	+3.1	+1.5
1814, Jan. 1	Camb., Eng.	μ Ceti	I	−0.75	−0.61	+0.09	+0.72	−0.72	−0.35	+0.19	−0.52	−0.59	+3.6	+2.2
28	Camb., Eng.	ξ² Ceti	I	−1.02	−0.77	−0.02	−0.25	+0.26	−0.05	+0.33	+0.07	−0.97	+5.7	+3.8
Feb. 1	Camb., Eng.	ν Geminor.	I	−0.98	−0.84	−0.42	−0.21	+0.47	−0.15	+0.03	+0.36	−0.53	+4.5	+2.6
1	Dorpat	ν Geminor.	I	−1.11	−0.96	+0.04	+0.02	−0.04	−0.19	+0.04	−0.14	−0.61	+3.2	+1.1
Oct. 1	Greenwich	μ Ceti	IB	−1.00	−0.43	−0.11	−0.29	+0.31	−0.04	+0.35	+0.10	+0.51	+1.3	−0.6
1	Paris	μ Ceti	IB	−0.95	−0.41	−0.15	−0.38	+0.41	+0.01	+0.34	+0.17	+0.48	−1.6	−3.4
1	Paris	μ Ceti	E	+0.82	+0.35	−0.23	−0.58	+0.63	+0.32	−0.23	+0.48	−0.40	−1.8	−0.6
1	Camb., Eng.	μ Ceti	IB	−1.00	−0.43	−0.10	−0.27	+0.29	−0.04	+0.34	+0.09	−0.51	−2.6	−4.5
1	Greenwich	μ Ceti	E	+0.90	+0.39	−0.19	−0.48	+0.52	+0.30	−0.26	+0.42	−0.45	−1.5	−0.2
1816, Apr. 12	Dorpat	κ Virginis	IB	−1.09	−0.75	−0.18	−0.19	−0.26	−0.12	−0.38	+0.16	+0.14	0.0	−2.1
1817, Dec. 30	Paris	γ Virginis	IB	−1.03	−0.68	−0.08	−0.01	−0.10	−0.09	−0.46	−0.04	+0.97	+1.6	−0.4
1818, Feb. 13	Paris	A Tauri	I	−0.89	+1.00	+0.08	−0.03	−0.08	−0.02	+0.27	−0.14	−0.97	+2.1	+0.4
13	Paris	39 Tauri	I	−0.82	+0.90	−0.39	+0.13	+0.42	+0.10	+0.26	+0.31	−0.88	+3.9	+2.3
1819, Sept. 8	Dorpat	ζ Arietis	IB	−0.80	+0.08	+0.46	−0.35	−0.58	−0.26	+0.25	−0.47	+0.67	−0.4	−1.9
Oct. 9	Dorpat	49 Aurigæ	IB	−0.92	+0.78	0.00	0.00	0.00	0.00	−0.02	−0.03	+0.95	−1.7	−3.4
1820, Feb. 1	Camb., Eng.	χ Leonis	IB	−0.81	+0.84	+0.40	+0.17	+0.43	−0.20	−0.35	+0.32	+0.47	−6.1	−7.6
1	Camb., Eng.	χ Leonis	E	+0.86	−0.89	+0.26	+0.11	+0.29	−0.13	+0.46	+0.13	−0.50	−0.7	+0.6
Apr. 23	Dorpat	χ Leonis	I	−0.36	+0.41	−0.86	−0.29	−0.91	+0.40	−0.29	−0.55	−0.32	−1.0	−1.7
Aug. 28	Dorpat	47 Arietis	IB	−0.83	−0.56	+0.27	−0.34	−0.44	−0.16	+0.27	−0.32	+0.78	−4.3	−5.9
28	Dorpat	47 Arietis	E	+1.03	+0.61	+0.11	−0.15	−0.19	+0.09	−0.33	−0.14	−0.85	+0.4	+1.9

GROUP IX—1821–1838.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1821, Feb. 6	Paris	62 Piscium	I	−1.07	−0.98	−0.18	+0.09	+0.20	−0.11	+0.49	+0.06	−0.77	−1.6	−3.6
6	Camb., Eng.	δ Piscium	I	−0.82	−0.74	+0.59	−0.30	−0.67	−0.46	+0.26	−0.12	−0.58	+1.8	+0.2
6	Paris	δ Piscium	I	−0.98	−0.89	+0.41	−0.21	−0.46	−0.41	+0.47	−0.08	−0.70	+0.6	−1.3
6	Dorpat	62 Piscium	I	−1.10	−1.00	+0.06	−0.03	−0.07	−0.25	+0.46	0.00	−0.79	−0.7	−2.8
6	Dorpat	δ Piscium	I	−0.65	−0.59	+0.72	−0.37	−0.81	−0.49	+0.18	−0.16	−0.47	+0.6	−0.6
6	Dorpat	δ Piscium	EB	+0.75	+0.68	−0.65	+0.34	+0.73	+0.49	−0.24	+0.15	+0.54	+1.7	+2.8
12	Paris	49 Aurigæ	I	−0.91	−0.09	+0.12	+0.34	+0.36	−0.07	−0.06	+0.38	−0.69	+0.3	−1.4
May 6	Dorpat	κ Geminor.	I	−0.98	+0.01	−0.01	−0.02	−0.02	−0.07	−0.19	−0.08	−0.86	+2.1	+0.2
6	Camb., Eng	κ Geminor.	I	−0.88	+0.05	+0.31	+0.24	+0.48	−0.16	−0.17	+0.47	−0.76	+0.6	−1.1
July 22	Dorpat	μ Arietis	IB	−0.83	−0.74	+0.27	−0.58	−0.64	−0.33	+0.22	−0.54	+0.76	−1.2	−2.8
23	Dorpat	16 Tauri	IB	−1.07	−0.86	+0.01	−0.07	−0.08	−0.18	+0.24	−0.04	+0.92	−2.5	−4.5
23	Dorpat	17 Tauri	IB	−0.87	−0.70	−0.10	+0.57	+0.58	0.00	+0.22	+0.51	+0.75	−3.4	−5.1
23	Dorpat	q Tauri	IB	−0.88	−0.71	+0.10	−0.56	−0.57	−0.24	+0.17	−0.45	+0.76	+0.7	−1.0
23	Dorpat	20 Tauri	IB	−1.07	−0.86	+0.01	−0.06	−0.06	−0.17	+0.23	−0.04	+0.92	−0.4	−2.4
23	Dorpat	21 Tauri	IB	−0.80	−0.65	+0.11	−0.65	−0.66	−0.25	+0.15	−0.54	+0.70	+0.8	−0.7
23	Dorpat	17 Tauri	E	+0.72	+0.58	−0.12	+0.73	+0.74	+0.28	−0.14	+0.60	−0.62	−0.2	+0.9
23	Paris	q Tauri	IB	−0.69	−0.55	+0.13	−0.75	−0.76	−0.27	+0.12	−0.63	+0.58	−3.6	−4.9
23	Paris	20 Tauri	IB	−1.03	−0.83	+0.05	−0.27	−0.27	−0.20	+0.21	−0.22	+0.80	−5.1	−7.1
23	Paris	22 Tauri	IB	−0.71	−0.57	+0.12	−0.73	−0.74	−0.27	+0.14	−0.61	+0.62	−3.8	−5.1
23	Paris	21 Tauri	IB	−0.54	−0.43	+0.14	−0.85	−0.86	−0.24	+0.08	−0.71	+0.46	+0.5	−0.5
23	Paris	21 Tauri	E	+0.73	+0.56	+0.11	−0.72	−0.73	−0.20	−0.23	−0.64	−0.63	−1.0	+0.1
23	Paris	16 Tauri	E	+1.06	+0.84	+0.01	−0.08	−0.08	+0.16	−0.23	−0.10	−0.93	−3.1	−1.5
23	Paris	Anon. 4	E	+1.06	+0.85	0.00	0.00	0.00	+0.17	−0.21	−0.04	−0.93	+1.9	+3.5
23	Paris	20 Tauri	E	+1.06	+0.84	0.00	−0.06	−0.06	+0.16	−0.23	−0.08	−0.93	+1.0	+2.6
23	Dorpat	16 Tauri	E	+1.06	+0.85	−0.02	+0.14	+0.14	+0.19	−0.22	+0.09	−0.91	−0.5	+1.1
23	Dorpat	20 Tauri	E	+1.05	+0.84	−0.03	+0.17	+0.17	+0.19	−0.22	+0.12	−0.90	−3.8	−2.2
Sept. 10	Paris	σ Aquarii	I	−0.94	−0.54	−0.52	−0.01	+0.52	+0.04	+0.44	−0.22	−0.18	+0.6	−1.2
Oct. 13	Camb., Eng.	17 Tauri	IB	−1.00	−0.83	−0.05	+0.47	+0.47	−0.09	+0.21	+0.42	+0.43	−5.8	−7.7
13	Camb., Eng.	q Tauri	IB	−0.89	−0.74	+0.06	−0.62	−0.62	−0.30	+0.16	−0.50	+0.40	−1.8	−3.5
13	Camb., Eng.	20 Tauri	IB	−1.12	−0.93	+0.01	−0.13	−0.13	−0.24	+0.22	−0.09	+0.50	−2.2	−4.3
13	Paris	17 Tauri	IB	−0.91	−0.75	−0.06	+0.59	+0.60	−0.05	+0.19	+0.53	+0.42	−5.5	−7.2
13	Paris	q Tauri	IB	−0.98	−0.82	+0.05	−0.50	−0.51	−0.29	+0.18	−0.40	+0.45	−2.7	−4.6
13	Paris	20 Tauri	IB	−1.13	−0.82	0.00	−0.01	−0.01	−0.25	+0.23	+0.04	+0.49	−2.3	−4.4
13	Paris	21 Tauri	IB	−0.92	−0.77	+0.05	−0.58	−0.58	−0.29	+0.17	−0.47	+0.43	−5.7	−7.4
13	Paris	17 Tauri	E	+0.69	+0.56	−0.07	+0.79	+0.80	+0.17	−0.11	+0.65	−0.30	−0.3	+0.7
13	Paris	16 Tauri	E	+1.10	+0.91	−0.02	+0.23	+0.24	+0.25	−0.20	+0.16	−0.51	−2.0	−0.4
13	Paris	q Tauri	E	+1.10	+0.91	+0.02	−0.24	−0.24	+0.16	−0.22	−0.23	−0.51	+1.5	+3.1
13	Paris	Anon. 4	E	+1.07	+0.89	−0.03	+0.33	+0.33	+0.27	+0.20	+0.25	−0.50	+0.7	+2.3
13	Paris	20 Tauri	E	+1.09	+0.90	−0.02	+0.28	+0.28	+0.26	−0.20	+0.21	−0.51	+1.4	+3.0
13	Paris	21 Tauri	E	+1.08	+0.89	+0.03	−0.32	−0.32	+0.15	−0.22	−0.30	−0.50	+0.7	+2.3
13	Camb., Eng.	17 Tauri	E	+0.83	+0.69	−0.06	+0.68	+0.68	+0.29	−0.14	+0.54	−0.35	−0.8	+0.4
13	Camb., Eng.	16 Tauri	E	+1.13	+0.93	−0.01	+0.10	+0.10	+0.24	−0.20	+0.05	−0.50	+1.2	+2.9
15	Camb., Eng.	136 Tauri	IB	−0.75	−0.49	−0.28	−0.65	−0.71	+0.10	0.00	−0.67	+0.58	−4.8	−6.2
15	Camb., Eng.	136 Tauri	E	+0.91	+0.59	−0.21	−0.49	−0.53	+0.13	0.00	−0.57	−0.70	−0.3	+1.1
Dec. 7	Dorpat	q Tauri	I	−1.12	−0.93	+0.01	−0.20	−0.20	−0.18	−0.14	−0.14	−0.34	−0.1	−2.2
7	Dorpat	17 Tauri	I	−0.21	−0.18	−0.04	+0.98	+0.98	+0.16	+0.06	+0.83	−0.07	+0.3	−0.1
7	Dorpat	17 Tauri	EB	+0.04	+0.04	−0.03	+1.00	+1.00	+0.20	+0.02	+0.84	+0.01	−0.3	+0.2
7	Dorpat	21 Tauri	I	−1.08	−0.90	+0.01	−0.33	−0.33	−0.27	+0.19	−0.24	−0.33	−0.7	−2.8
7	Dorpat	q Tauri	EB	+1.14	+0.95	0.00	−0.07	−0.07	+0.21	−0.21	−0.10	+0.35	+0.3	+2.0
1822, Feb. 8	Paris	υ Leonis	IB	−0.09	+0.06	+0.89	−0.44	+0.99	−0.47	+0.06	+0.12	+0.06	−5.6	−5.8
8	Paris	υ Leonis	E	+0.23	−0.12	+0.86	−0.44	+0.97	−0.41	+0.20	+0.09	−0.11	+0.1	+0.4
8	Dorpat	υ Leonis	IB	−0.92	+0.52	+0.22	−0.11	+0.25	−0.18	−0.43	+0.19	+0.47	−2.5	−4.2
8	Dorpat	υ Leonis	E	+0.95	−0.54	+0.01	−0.01	+0.01	+0.06	+0.45	+0.04	−0.48	+1.2	+2.6
27	Dorpat	q Tauri	I	−0.38	−0.36	+0.05	+0.94	+0.94	+0.12	+0.08	+0.81	−0.36	−4.4	−5.1
27	Dorpat	21 Tauri	I	−0.72	+0.66	+0.04	+0.74	+0.75	+0.03	+0.14	+0.67	−0.66	+0.6	−0.8
27	Dorpat	q Tauri	EB	+0.43	+0.41	+0.03	+0.49	+0.49	+0.24	−0.07	+0.75	+0.41	−3.6	−3.0
Apr. 30	Paris	d Leonis	I	−0.88	+0.20	−0.35	+0.13	−0.37	+0.11	−0.47	−0.04	−0.83	+0.9	−0.8
May 1	Dorpat	υ Leonis	I	−0.40	+0.16	−0.78	+0.46	−0.90	+0.40	−0.31	−0.50	−0.33	+0.8	0.0
1	Dorpat	υ Leonis	EB	+0.15	−0.06	−0.84	+0.51	−0.99	+0.46	−0.04	−0.57	+0.13	−2.1	−1.9
Aug. 10	Dorpat	17 Tauri	E	+1.02	+0.93	+0.06	+0.33	+0.34	+0.22	−0.19	+0.24	−0.92	+1.3	+2.8
10	Dorpat	16 Tauri	E	+1.03	+0.94	−0.06	−0.30	−0.31	+0.10	−0.20	−0.32	−0.93	+4.9	+6.4
10	Dorpat	20 Tauri	IB	−0.95	−0.87	−0.09	−0.46	−0.47	−0.22	+0.16	−0.35	+0.86	−2.5	−4.3
10	Dorpat	q Tauri	E	+0.51	+0.46	−0.17	−0.86	−0.88	−0.08	−0.10	−0.77	−0.46	+2.7	+3.5
10	Dorpat	η Tauri	IB	−0.55	−0.52	+0.16	+0.84	+0.86	+0.08	+0.12	+0.76	+0.51	−3.2	−4.2
10	Dorpat	22 Tauri	E	+0.45	+0.40	−0.17	−0.89	−0.91	−0.09	−0.09	−0.80	−0.40	+3.7	+4.4
10	Dorpat	20 Tauri	E	+1.01	+0.92	−0.07	−0.34	−0.35	+0.09	−0.19	−0.35	−0.91	+2.5	+4.0
10	Dorpat	η Tauri	E	+0.41	+0.38	+0.18	+0.91	+0.92	+0.23	−0.05	+0.76	−0.37	+0.3	+0.9
Sept. 6	Camb., Eng.	q Tauri	IB	−1.07	−0.97	+0.03	+0.14	+0.14	−0.13	+0.19	+0.17	+0.93	−5.1	−7.1
Oct. 31	Dorpat	23 Tauri	IB	−1.14	−0.95	+0.02	+0.08	+0.08	−0.21	+0.20	+0.13	+0.28	−2.6	−4.8
31	Dorpat	η Tauri	IB	−1.13	−0.93	−0.05	−0.18	−0.18	−0.26	+0.19	−0.09	+0.27	−1.9	−4.0

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1822, Oct. 31	Dorpat	23 Tauri	E	+1.10	+0.91	+0.07	+0.26	−0.27	+0.26	−0.17	+0.18	−0.27	+1.3	+2.9
31	Dorpat	27 Tauri	IB	−1.05	−0.88	+0.11	+0.39	+0.41	−0.14	+0.15	+0.40	+0.26	−1.9	−3.9
31	Dorpat	η Tauri	E	+1.15	+0.95	+0.01	+0.02	+0.02	+0.26	−0.19	−0.04	−0.28	+4.4	+6.1
31	Dorpat	27 Tauri	E	+0.92	+0.77	+0.16	+0.57	+0.59	+0.28	−0.14	+0.45	−0.23	+3.0	+4.4
Nov. 30	Dorpat	ε Geminor.	IB	−1.13	−0.96	−0.11	−0.07	−0.13	−0.21	−0.14	−0.06	+0.38	−3.3	−5.4
Dec. 25	Dorpat	17 Tauri	I	−1.12	−0.93	−0.05	−0.15	−0.15	−0.24	+0.18	−0.06	−0.55	−1.5	−3.6
25	Paris	η Tauri	I	−1.07	−0.88	+0.10	+0.32	+0.34	−0.14	+0.18	+0.35	−0.53	+1.2	−0.8
25	Dorpat	16 Tauri	I	−0.76	−0.63	−0.23	−0.71	−0.74	−0.29	+0.13	−0.59	−0.38	−0.1	−1.5
25	Dorpat	20 Tauri	I	−0.73	−0.60	−0.23	−0.73	−0.76	−0.26	+0.10	−0.60	−0.36	+0.6	−0.8
25	Dorpat	η Tauri	I	−0.97	−0.81	+0.16	+0.39	+0.52	−0.10	+0.16	+0.49	−0.48	−0.8	−2.6
25	Dorpat	η Tauri	EB	+0.83	+0.69	+0.22	+0.65	+0.69	+0.28	−0.13	+0.54	+0.41	+0.4	+1.6
25	Dorpat	28 Tauri	I	−0.60	−0.50	+0.27	+0.80	+0.85	+0.03	+0.11	+0.76	−0.30	−0.8	−1.9
1823, Jan. 24	Camb., Eng.	ε Geminor.	I	−1.13	−0.97	+0.08	+0.05	+0.09	−0.24	−0.14	+0.16	−0.45	+0.8	−1.2
24	Dorpat	ε Geminor.	I	−1.13	−0.97	+0.04	+0.02	+0.04	−0.23	−0.12	+0.11	−0.45	+0.2	−1.8
24	Dorpat	ε Geminor.	EB	+1.13	+0.97	+0.05	+0.03	+0.06	+0.21	+0.12	−0.01	+0.45	+3.1	+4.6
May 18	Camb., Eng.	p^5 Leonis	I	−0.83	−0.36	+0.40	−0.40	+0.57	−0.34	−0.31	+0.22	−0.79	+1.6	+0.1
June 17	Paris	69 Virginis	I	−0.49	+0.06	+0.09	−0.86	+0.86	−0.33	−0.13	−0.31	−0.48	+0.5	−0.4
Sept. 23	Dorpat	μ Arietis	E	+1.01	+0.41	−0.06	−0.20	−0.20	+0.05	−0.28	−0.24	−0.70	+2.7	+4.1
1824, Jan. 7	Camb., Eng.	19 Piscium	I	−0.58	+0.32	+0.30	−0.72	−0.78	−0.34	+0.19	+0.10	−0.60	+0.6	−0.4
Mar. 12	Paris	o Leonis	I	−1.12	−0.97	+0.12	−0.09	+0.16	−0.29	−0.36	+0.18	−0.52	−0.5	−2.5
Sept. 4	Dorpat	ρ Capricor.	I	−0.68	+0.66	−0.58	+0.30	+0.65	+0.18	+0.25	−0.45	−0.53	−1.0	−2.2
Dec. 7	Paris	μ Geminor.	E	+1.02	+0.43	−0.24	+0.01	−0.24	+0.16	+0.10	−0.33	−0.33	−1.0	+0.4
31	Paris	ζ Arietis	I	−0.78	+0.23	+0.46	+0.38	+0.60	+0.08	+0.16	+0.20	−0.56	0.0	−1.4
1825, Jan. 3	Dorpat	1 Geminor.	I	−0.72	−0.23	−0.73	−0.08	−0.73	−0.05	−0.05	−0.67	−0.12	−1.0	−2.3
Feb. 11	Paris	θ Ophiuchi	E	+0.82	+0.08	−0.53	−0.08	+0.54	−0.03	+0.14	−0.45	−0.78	+3.0	+4.1
27	Dorpat	η Geminor.	I	−0.93	−0.31	−0.41	+0.03	−0.41	−0.06	−0.08	−0.33	−0.77	+0.2	−1.5
Mar. 24	Dorpat	A Tauri	I	−0.93	+0.24	+0.16	+0.07	+0.18	0.00	+0.10	+0.27	−0.90	+2.0	+0.3
24	Dorpat	39 Tauri	I	−0.95	+0.21	+0.42	+0.18	+0.46	−0.08	+0.09	+0.50	−0.82	+0.6	−1.1
28	Paris	g Geminor.	I	−0.63	−0.36	−0.71	+0.37	−0.80	+0.10	−0.17	−0.67	−0.54	−0.8	−1.9
Apr. 1	Camb., Eng.	c Leonis	I	−1.05	+0.91	+0.03	−0.42	+0.42	−0.41	−0.32	+0.15	−0.27	+0.2	−1.7
June 27	Paris	19 Scorpii	I	−0.41	−0.21	−0.89	−0.24	+0.92	−0.12	−0.03	−0.79	−0.24	+1.2	+0.5
July 4	Paris	κ Aquarii	IB	−0.70	+0.67	−0.15	+0.63	+0.65	+0.24	+0.33	−0.20	+0.60	−4.9	−6.2
4	Paris	κ Aquarii	E	+0.52	−0.50	−0.18	+0.80	+0.82	+0.31	−0.16	−0.36	−0.43	+0.6	+1.3
27	Dorchester	o Sagittarii	I	−0.56	+0.01	−0.76	+0.33	+0.83	+0.08	+0.11	−0.76	−0.27	+2.8	+1.8
27	Dorchester	o Sagittarii	EB	+0.62	−0.01	−0.71	+0.31	+0.78	+0.18	−0.10	−0.81	+0.31	+0.9	+1.8
27	Dorchester	π Sagittarii	I	−0.50	+0.01	+0.78	−0.37	−0.86	−0.17	+0.06	+0.88	−0.25	+3.2	+2.3
Sept. 4	Paris	67 Tauri	IB	−0.82	+0.42	−0.46	−0.09	−0.47	−0.03	+0.06	−0.35	+0.87	−6.2	−7.7
4	Paris	κ Tauri	IB	−0.56	+0.29	−0.78	−0.16	−0.80	−0.05	+0.04	−0.67	−0.96	−2.7	−3.7
4	Paris	67 Tauri	E	+0.91	−0.47	−0.22	−0.04	−0.22	−0.01	−0.07	−0.28	+0.59	+4.1	+5.4
23	Dorpat	c^2 Capricor.	I	−0.85	+0.54	+0.15	−0.36	−0.38	−0.14	+0.28	+0.29	−0.64	+2.7	+1.2
Dec. 14	Cracow	c^1 Capricor.	I	−0.76	+0.34	−0.20	+0.58	+0.62	+0.18	+0.31	−0.30	−0.62	−2.3	−3.7
1826, Jan. 13	Camb., Eng.	19 Piscium	I	−0.78	+0.71	−0.15	−0.52	−0.54	−0.19	+0.26	+0.11	−0.71	+3.2	+1.8
Feb. 15	Dorpat	53 Tauri	I	−0.84	+0.71	+0.39	+0.02	+0.40	+0.05	+0.08	+0.44	−0.89	−0.9	−2.4
16	Dorpat	105 Tauri	I	−0.93	+0.62	+0.09	−0.01	+0.09	−0.01	+0.02	+0.21	−0.90	−0.5	−2.2
May 12	Berlin	1 Cancri	I	−0.65	+0.06	−0.45	+0.59	−0.74	+0.13	−0.18	−0.60	−0.64	−1.1	−2.2
13	Berlin	A^2 Cancri	I	−0.98	−0.14	0.00	0.00	0.00	−0.07	−0.28	+0.09	−1.00	−2.0	−3.7
July 27	Berlin	53 Arietis	IB	−0.76	+0.02	+0.52	+0.12	+0.53	+0.12	+0.15	+0.44	+0.83	−5.8	−7.1
Sept. 13	Paris	c^1 Capricor.	I	−0.91	−0.06	−0.03	+0.40	+0.41	+0.05	+0.30	−0.34	−0.51	+0.6	−1.0
21	Berlin	43 Tauri	E	+0.78	−0.86	−0.48	−0.04	+0.48	+0.01	−0.09	+0.37	−0.78	−0.3	+0.8
Oct. 24	Paris	κ Cancri	E	+0.96	−0.10	−0.04	+0.18	−0.19	+0.12	+0.28	−0.09	−0.92	+2.0	+3.3
1827, Jan. 5	Paris	π Piscium	I	−0.86	+0.67	+0.31	+0.15	+0.34	+0.12	+0.29	+0.20	−0.93	+0.5	−1.0
14	Greenwich	κ Cancri	IB	−0.89	+0.29	+0.05	−0.37	+0.38	−0.15	−0.26	+0.33	+0.34	−2.5	−4.0
14	Greenwich	κ Cancri	E	+0.90	−0.29	+0.04	−0.35	+0.35	−0.05	+0.29	+0.19	−0.34	+3.6	+4.8
19	Greenwich	i Virginis	E	+0.59	+0.44	−0.73	−0.39	+0.82	−0.18	+0.19	−0.36	−0.56	+1.9	+2.7
Feb. 10	Dorchester	α Cancri	I	−0.54	+0.23	−0.12	+0.82	−0.83	+0.07	−0.06	−0.68	−0.45	−5.0	−5.9
10	Paris	60 Cancri	I	−0.96	+0.40	−0.02	+0.15	−0.15	+0.01	−0.28	−0.05	−0.08	−1.7	−3.3
July 2	Paris	49 Virginis	I	−0.77	−0.38	−0.60	−0.27	+0.65	−0.25	−0.19	−0.14	−0.72	+0.2	−1.1
2	Cracow	49 Virginis	I	−0.85	−0.42	−0.52	−0.23	+0.57	−0.24	+0.09	−0.10	−0.46	−4.3	−5.7
Aug. 1	Cracow	41 Libræ	I	−0.92	−0.77	−0.49	+0.13	+0.51	−0.18	−0.19	−0.36	−0.85	+1.9	+0.3
29	Cracow	58 G. Scorpii	I	−0.82	−0.71	−0.61	−0.17	+0.63	−0.14	−0.07	−0.53	−0.76	−0.9	−2.3
Nov. 16	Dorchester	α Virginis	IB	−1.01	−0.30	+0.27	+0.06	−0.28	−0.02	−0.30	+0.17	+0.46	+3.2	+1.5
28	Dorchester	ε Piscium	I	−0.97	−0.05	+0.03	+0.01	+0.03	0.00	+0.30	+0.05	−0.86	+5.0	+3.4
Dec. 8	Greenwich	ω Leonis	IB	−0.91	+0.75	−0.01	+0.05	+0.05	0.00	−0.28	+0.08	+0.91	−2.6	−4.1
8	Greenwich	ω Leonis	E	+0.89	−0.74	−0.06	−0.19	+0.20	+0.04	+0.26	−0.17	−0.90	−2.3	−1.1
8	Camb., Eng.	ω Leonis	E	+0.89	−0.73	+0.06	+0.22	−0.22	+0.05	+0.26	−0.20	−0.88	−1.1	+0.1
1828, Feb. 22	Cracow	68 Tauri	I	−0.85	+0.60	+0.30	−0.23	+0.39	+0.06	+0.11	+0.37	−0.92	−3.1	−4.5
Mar. 23	Greenwich	26 Geminor.	I	−0.87	+0.91	+0.09	−0.26	−0.28	+0.03	−0.09	−0.24	−0.95	−1.6	−3.1
24	Greenwich	68 Geminor.	I	−0.89	+0.99	+0.01	−0.11	+0.11	+0.01	−0.15	+0.09	−0.94	+0.6	−0.9
24	Berlin	68 Geminor.	IB	−0.89	+0.99	−0.05	−0.14	−0.15	+0.04	−0.16	−0.09	+0.24	+0.7	−0.8
24	Berlin	67 Geminor.	IB	−0.71	+0.79	+0.21	+0.58	+0.61	−0.09	−0.12	+0.63	+0.19	−2.4	−3.6

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													$''$	$''$
1828, June 16	Cracow	κ Cancri	I	−0.90	+0.98	−0.02	−0.05	+0.06	+0.03	−0.36	−0.05	−0.76	+1.2	−0.3
Aug. 16	Dorchester	λ Virginis	I	−0.85	−0.02	−0.46	+0.12	+0.48	−0.13	−0.19	−0.22	−0.86	+7.2	+5.8
1829, Jan. 18	Camb., Eng.	λ Geminor.	I	−0.75	+0.58	−0.04	−0.58	+0.58	−0.04	−0.07	+0.57	−0.23	+1.6	+0.4
Apr. 12	Cracow	α Cancri	I	−0.66	+0.63	−0.38	−0.57	+0.69	−0.11	−0.23	+0.54	−0.77	−0.2	−1.3
June 13	Cracow	μ Libræ	I	−0.80	+0.37	−0.44	+0.35	+0.57	−0.15	−0.17	−0.44	−0.47	+0.5	−0.8
13	Paris	μ Libræ	I	−0.72	+0.33	−0.59	+0.46	+0.74	−0.15	−0.15	−0.41	−0.44	+0.9	−0.2
Aug. 21	Paris	70 Tauri	E	+0.76	+0.29	+0.28	−0.59	+0.66	+0.14	−0.09	+0.60	−0.75	−3.1	−2.2
21	Dorchester	α Tauri	IB	−0.92	−0.34	+0.17	+0.38	−0.42	−0.13	+0.11	−0.39	+0.91	+5.1	+3.7
21	Dorchester	α Tauri	E	+0.98	+0.36	−0.09	+0.22	−0.24	+0.06	−0.12	−0.23	−0.97	−5.9	−4.8
21	Paris	α Tauri	IB	−0.94	−0.34	+0.14	−0.33	+0.36	−0.04	+0.12	+0.33	+0.93	+3.3	+1.9
Sept. 17	Dorchester	α Tauri	IB	−1.00	+0.37	+0.09	−0.23	+0.25	−0.05	+0.12	+0.22	+0.75	−0.8	−2.3
23	Dorchester	o Leonis	IB	−0.52	+0.44	+0.65	−0.50	+0.83	−0.17	−0.11	+0.50	+0.41	−1.2	−2.0
23	Dorchester	o Leonis	E	+0.56	−0.39	+0.70	+0.53	+0.87	−0.11	+0.15	+0.54	−0.36	−8.3	−7.7
Oct. 15	Paris	α Tauri	IB	−0.75	−0.33	−0.25	+0.67	−0.71	−0.19	+0.09	−0.66	+0.41	+0.4	−0.7
15	Camb., Eng.	α Tauri	IB	−0.60	−0.26	−0.29	+0.77	−0.83	−0.18	+0.06	−0.77	+0.32	+1.2	+0.3
15	Camb., Eng.	α Tauri	E	+0.74	+0.33	−0.24	+0.68	−0.72	+0.01	−0.09	−0.67	−0.40	0 0	+0.8
15	Paris	α Tauri	E	+0.88	+0.39	−0.20	+0.54	−0.57	+0.06	−0.10	−0.54	−0.48	−0.4	+0.4
Nov. 11	Dorchester	α Tauri	IB	−0.63	−0.27	−0.25	−0.78	+0.81	0.00	+0.09	+0.75	+0.11	−0.6	−1.6
11	Dorchester	α Tauri	E	+0.76	+0.33	+0.21	−0.68	+0.71	+0.20	−0.08	+0.66	−0.14	−1.4	−0.6
Dec. 9	Cracow	α Tauri	I	−1.08	−0.53	−0.03	+0.05	−0.05	−0.13	+0.06	−0.05	−0.27	+2.2	+0.6
1830, Jan. 5	Dorchester	α Tauri	I	−0.77	−0.41	+8.18	−0.66	+0.68	−0.02	+0.09	+0.64	−0.49	+0.4	−0.8
5	Greenwich	α Tauri	I	−1.02	−0.54	−0.06	−0.23	−0.24	−0.16	+0.13	−0.24	−0.65	−4.4	−5.9
Mar. 2	Cracow	130 Tauri	I	−0.86	−0.35	+0.05	+0.53	−0.54	−0.10	−0.05	−0.54	−0.78	+0.7	−0.6
3	Cracow	26 Geminor.	I	−0.84	−0.17	+0.16	+0.50	−0.53	−0.06	−0.12	−0.52	−0.74	+0.4	−0.9
3	Berlin	26 Geminor.	I	−0.80	−0.17	+0.18	+0.56	−0.58	−0.04	−0.03	−0.60	−0.76	−0.2	−1.4
28	Camb., Eng.	θ^1 Tauri	I	−1.04	−0.68	+0.06	−0.27	+0.28	−0.12	+0.16	+0.22	−0.79	+2.4	+0.8
28	Camb., Eng.	θ^2 Tauri	I	−0.85	−0.55	+0.14	−0.63	+0.65	+0.22	−0.12	+0.60	+0.64	−2.0	−3.3
28	Greenwich	θ^1 Tauri	I	−1.03	−0.67	+0.07	−0.31	+0.32	−0.12	+0.14	+0.26	−0.79	+2.0	+0.5
28	Greenwich	θ^2 Tauri	I	−0.82	+0.54	+0.14	−0.64	+0.65	−0.03	+0.13	+0.58	−0.63	+1.1	−0.1
28	Greenwich	264 B. Tauri	I	−1.00	+0.65	−0.08	+0.37	−0.38	−0.20	+0.12	−0.36	−0.77	+4.9	+3.4
28	Greenwich	85 Tauri	I	−0.41	−0.26	+0.18	+0.91	+0.93	+0.05	+0.06	+0.84	−0.31	+2.5	+1.9
28	Camb., Eng.	85 Tauri	I	−0.47	−0.31	+0.18	−0.88	+0.90	+0.06	+0.08	+0.80	−0.36	+2.0	+1.3
28	Dorchester	α Tauri	I	−1.02	−0.67	−0.06	+0.31	−0.32	−0.19	+0.12	−0.32	−8.78	+1.7	+0.2
28	Dorchester	α Tauri	EB	+1.02	+0.67	−0.06	−0.31	−0.31	+0.11	−0.14	−0.28	+0.78	−3.0	−1.9
29	Berlin	111 Tauri	EB	+1.04	+0.53	0.00	+0.13	−0.13	+0.12	−0.07	−0.12	+0.91	+1.9	+0.6
29	Berlin	117 Tauri	I	−0.90	−0.46	−0.02	−0.51	+0.51	−0.07	+0.08	+0.48	−0.78	−3.9	−2.8
29	Greenwich	117 Tauri	I	−0.78	−0.40	−0.02	−0.67	−0.67	−0.05	+0.05	+0.65	−0.67	+2.3	+1.2
29	Camb., Eng.	117 Tauri	I	−0.66	−0.42	−0.03	−0.77	+0.77	+0.09	+0.06	+0.60	−0.70	+3.5	+2.5
Apr. 5	Greenwich	τ Leonis	I	−0.90	+0.85	−0.10	0.00	+0.10	+0.02	−0.28	+0.01	−0.50	+2.1	+0.8
5	Camb., Eng.	τ Leonis	I	−0.90	+0.86	−0.06	0.00	+0.06	+0.03	−0.31	+0.01	−0.50	+2.3	+1.0
28	Cracow	1 Cancri	I	−0.85	0.00	−0.32	−0.39	+0.51	−0.08	−0.19	+0.48	−0.86	+1.2	−0.1
28	Berlin	1 Cancri	I	−0.86	+0.02	−0.32	−0.39	+0.51	−0.11	−0.10	+0.44	−0.83	+0.5	−0.8
May 1	Camb., Eng.	48 Leonis	I	−0.90	+0.65	+0.15	+0.03	−0.15	+0.07	−0.28	−0.07	−0.92	+2.9	+1.6
1	Cracow	48 Leonis	I	−0.86	+0.62	+0.32	+0.06	−0.32	+0.13	−0.37	−0.14	−0.85	+1.9	+0.6
June 4	Cracow	η Libræ	I	−0.75	+0.67	+0.20	−0.55	−0.59	+0.12	−0.13	+0.48	−0.23	+1.8	+0.7
25	Cracow	o Sextantis	I	−0.84	+0.55	−0.44	−0.04	+0.44	−0.11	−0.33	+0.16	−0.82	−3.1	−4.3
July 15	Dorchester	α Tauri	IB	−0.63	−0.48	−0.08	+0.81	−0.81	−0.21	+0.08	−0.77	+0.45	0.0	−0.9
16	Cracow	α Tauri	IB	−0.71	−0.53	−0.06	+0.75	−0.76	−0.18	+0.03	−0.71	+0.44	+0.7	−0.3
Aug. 1	Cracow	110 B. Sagittarii	I	−0.90	+0.28	−0.17	−0.38	−0.41	−0.04	0.00	+0.39	+0.45	+0.2	−1.1
Sept. 5	Berlin	ν Piscium	IB	−0.86	−0.75	+0.47	−0.43	+0.64	+0.06	+0.26	+0.21	+0.46	−2.4	−3.6
5	Berlin	ν Piscium	E	+0.80	+0.71	+0.51	−0.48	+0.70	+0.33	−0.18	+0.32	−0.43	−1.6	−0.8
Oct. 5	Greenwich	θ^1 Tauri	IB	−1.10	−0.91	−0.01	+0.13	−0.14	−0.21	+0.15	−0.15	+0.71	+1.0	−0.6
5	Greenwich	θ^2 Tauri	IB	−1.09	−0.88	+0.01	−0.20	+0.20	−0.13	+0.17	+0.15	+0.70	+0.5	−1.1
5	Greenwich	85 Tauri	IB	−0.53	−0.45	+0.03	−0.88	+0.88	+0.05	+0.08	+0.79	+0.36	−4.7	−5.5
20	Berlin	24 Scorpii	I	−0.59	+0.55	−0.02	−0.75	−0.76	+0.12	−0.10	+0.69	−0.46	+1.5	+0.6
20	Cracow	24 Scorpii	I	−0.67	+0.62	−0.02	−0.67	−0.67	+0.12	−0.04	+0.60	−0.56	+2.5	+1.5
23	Cracow	d Sagittarii	I	−0.95	+0.29	−0.02	−0.02	−0.02	−0.01	+0.18	−0.03	−0.98	+0.9	−0.5
30	Berlin	ν Piscium	I	−0.76	−0.64	+0.52	−0.54	+0.75	+0.09	+0.24	+0.26	−0.17	+0.8	−0.3
Dec. 22	Cracow	29 Piscium	I	−0.90	−0.62	+0.48	−0.19	+0.52	+0.08	+0.34	−0.01	−0.84	+0.9	−0.4
1831, Jan. 20	Cracow	ν Piscium	I	−1.02	−0.88	+0.18	−0.23	+0.29	−0.03	+0.30	+0.06	−0.96	+4.3	+2.9
20	Berlin	ν Piscium	I	−1.06	−0.91	+0.07	−0.09	+0.11	−0.09	+0.30	−0.01	−0.99	+4.4	+2.9
21	Dorchester	μ Ceti	I	−0.80	−0.74	−0.26	+0.62	+0.67	+0.06	+0.23	+0.38	−0.72	+5.2	+4.1
21	Berlin	μ Ceti	I	−0.89	−0.82	+0.21	−0.52	+0.56	+0.02	+0.25	+0.32	−0.82	+1.2	0.0
22	Cracow	f Tauri	I	−0.47	−0.43	+0.17	−0.88	+0.90	+0.15	+0.10	+0.68	−0.46	+0.5	−0.2
26	Greenwich	f Geminor.	I	−0.97	−0.49	+0.32	+0.29	−0.43	−0.10	−0.10	−0.43	−0.29	+2.4	+1.0
Feb. 4	Dorchester	γ Libræ	IB	−0.79	+0.86	−0.08	+0.47	+0.47	−0.07	−0.19	−0.39	+0.88	−2.8	−3.9
4	Dorchester	γ Libræ	E	+0.87	−0.95	−0.04	+0.23	+0.23	−0.08	+0.23	−0.15	−0.97	−3.8	−2.9
19	Cracow	48 Tauri	I	−1.08	−0.98	0.00	−0.04	+0.04	−0.12	+0.11	−0.01	−1.00	+2.3	+0.8
19	Greenwich	48 Tauri	I	−1.07	−0.98	0.00	+0.13	−0.13	−0.18	+0.19	−0.16	−0.98	+3.9	+2.4
19	Cracow	γ Tauri	I	−1.04	−0.95	+0.01	+0.25	−0.25	−0.17	+0.10	−0.27	−0.94	+2.8	+1.4

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1831, Feb. 19	Dorchester	α Tauri	I	−0.49	−0.45	+0.11	+0.88	−0.89	−0.20	+0.06	−0.84	−0.45	+2.6	+1.9
20	Greenwich	111 Tauri	I	−0.77	−0.66	−0.22	−0.66	+0.69	−0.04	+0.08	+0.65	−0.68	+1.5	+0.4
20	Camb., Eng.	111 Tauri	I	−0.80	−0.69	−0.21	−0.63	+0.66	−0.05	+0.07	+0.62	−0.73	+1.1	0.0
Apr. 15	Berlin	α Tauri	I	−1.01	−0.88	+0.07	+0.44	−0.45	−0.27	+0.15	−0.47	−0.61	+3.6	+2.2
May 22	Greenwich	l Virginis	I	−0.76	+0.57	−0.32	+0.46	+0.56	−0.17	−0.24	−0.23	−0.61	+1.7	+0.6
June 21	Greenwich	γ Libræ	I	−0.83	+0.89	+0.02	−0.39	−0.39	−0.07	+0.21	+0.28	−0.55	+2.8	+1.7
21	Cracow	γ Libræ	I	−0.73	+0.78	+0.02	−0.59	−0.59	+0.16	−0.13	+0.45	−0.53	+2.7	+1.7
July 31	Greenwich	ξ² Ceti	E	+1.03	+0.83	−0.08	+0.25	−0.26	+0.04	−0.30	−0.08	−0.96	−0.3	+0.7
Aug. 28	Dorchester	f Tauri	IB	−0.85	−0.73	0.00	−0.61	+0.61	+0.01	+0.21	+0.56	+0.77	−2.0	−3.2
29	Dorchester	γ Tauri	IB	−0.84	−0.76	+0.13	+0.61	−0.62	−0.24	+0.14	−0.61	+0.78	−1.9	−3.0
29	Dorchester	γ Tauri	E	+0.96	+0.87	+0.10	+0.45	−0.46	+0.06	−0.17	−0.36	−0.89	−1.7	−0.8
29	Dorchester	α Tauri	IB	−1.07	−0.98	−0.02	−0.08	+0.09	−0.15	+0.20	+0.02	+1.00	+1.1	−0.3
29	Dorchester	θ¹ Tauri	IB	−0.34	−0.50	+0.23	+0.92	+0.95	+0.53	+0.19	+0.43	+0.85	−3.1	−3.6
29	Dorchester	θ² Tauri	IB	−0.39	−0.35	−0.23	−0.90	+0.93	+0.10	+0.08	+0.84	+0.36	−0.1	−0.6
29	Dorchester	θ² Tauri	E	+0.15	+0.14	−0.25	−0.96	+0.99	+0.20	−0.01	+0.90	−0.14	−2.2	−2.0
Oct. 14	Dorchester	π Capricor.	I	−0.78	+0.55	−0.52	−0.15	−0.54	−0.06	+0.09	+0.40	−0.81	+4.1	+3.1
21	Greenwich	ξ² Ceti	IB	−0.98	−0.65	+0.11	−0.48	+0.49	−0.03	+0.28	+0.24	+0.11	+0.8	−0.5
21	Greenwich	ξ² Ceti	E	+0.86	+0.57	+0.14	−0.62	+0.64	+0.35	−0.21	+0.42	−0.08	−2.0	−1.1
23	Greenwich	θ¹ Tauri	IB	−0.98	−0.84	−0.14	−0.47	+0.50	−0.10	+0.19	+0.39	+0.48	+0.2	−1.1
23	Greenwich	θ² Tauri	IB	−0.56	−0.48	−0.25	−0.83	+0.87	+0.07	+0.11	+0.75	+0.28	−1.3	−2.0
23	Greenwich	75 Tauri	I	−0.54	−0.48	+0.26	+0.84	−0.88	−0.27	+0.08	−0.83	+0.27	−2.7	−3.4
23	Greenwich	θ¹ Tauri	E	+0.86	+0.75	−0.19	−0.62	+0.65	+0.28	−0.15	+0.64	−0.42	−1.6	−0.7
23	Greenwich	75 Tauri	E	+0.73	+0.62	+0.23	+0.73	−0.77	0.00	−0.15	−0.64	−0.35	−1.3	−0.6
23	Greenwich	99 Tauri	E	+1.06	+0.91	−0.10	−0.33	+0.34	+0.27	−0.19	+0.35	−0.52	−0.1	+0.9
23	Dorchester	α Tauri	IB	−1.02	−0.88	+0.13	+0.40	−0.42	−0.26	+0.15	−0.44	+0.52	−0.9	−2.2
23	Dorchester	α Tauri	E	+1.08	+0.93	+0.09	+0.26	−0.28	+0.15	−0.19	−0.19	−0.55	−2.9	−1.9
23	Greenwich	α Tauri	IB	−1.07	−0.92	−0.10	−0.29	+0.31	−0.15	+0.19	+0.23	+0.53	+1.2	−0.2
23	Camb., Eng.	α Tauri	IB	−1.08	−0.93	−0.09	−0.26	+0.28	−0.15	+0.19	+0.19	+0.53	+2.7	+1.3
23	Camb., Eng.	α Tauri	E	+1.02	+0.88	−0.14	−0.40	+0.42	+0.27	−0.17	+0.45	−0.50	−2.3	−1.3
23	Greenwich	α Tauri	E	+1.00	+0.86	−0.15	−0.43	+0.46	+0.27	−0.17	+0.48	−0.49	−1.6	−0.6
23	Cracow	α Tauri	IB	−0.88	−0.77	−0.20	−0.59	+0.62	−0.04	+0.06	+0.54	+0.48	+1.1	−0.1
23	Cracow	α Tauri	E	+0.83	+0.72	−0.23	−0.64	+0.68	+0.25	−0.04	+0.67	−0.38	−1.9	−1.2
Nov. 16	Greenwich	33 Ceti	I	−0.71	−0.30	−0.39	+0.64	−0.75	−0.35	+0.17	−0.25	−0.35	+0.7	−0.2
24	Greenwich	π Cancri	E	+0.23	+0.16	−0.98	−0.04	+0.98	−0.16	+0.06	+0.70	−0.20	0.0	+0.2
Dec. 17	Cracow	γ Tauri	I	−1.11	−0.90	−0.08	−0.26	+0.27	−0.15	+0.09	+0.18	−0.35	+1.3	−0.2
17	Berlin	γ Tauri	I	−1.14	−0.93	−0.04	−0.13	+0.14	−0.20	+0.21	+0.05	−0.35	+1.3	−0.2
18	Greenwich	119 Tauri	I	−1.08	−0.93	+0.21	+0.30	−0.37	−0.27	+0.12	−0.43	−0.11	−0.2	−1.6
1832, Jan. 5	Cracow	θ Capricor.	I	−0.91	+0.76	−0.12	0.00	−0.12	−0.02	+0.26	0.00	−0.53	+1.3	+0.1
Feb. 10	Cracow	α Tauri	I	−0.97	−0.83	−0.18	−0.40	+0.44	−0.04	+0.07	+0.35	−0.88	+3.2	+1.9
10	Cracow	α Tauri	EB	+0.89	+0.76	−0.25	−0.52	+0.58	+0.22	−0.05	+0.58	+0.69	−2.0	−1.2
15	Berlin	ψ Leonis	I	−0.92	−0.72	+0.55	+0.06	−0.55	−0.03	−0.20	−0.40	−0.07	+1.0	−0.2
15	Berlin	α Leonis	I	−1.10	−0.80	−0.05	0.00	+0.05	−0.21	−0.23	−0.03	−0.08	−4.1	−5.5
15	Cracow	α Leonis	I	−1.10	−0.64	−0.04	−0.01	+0.04	−0.17	−0.30	+0.08	−0.08	+1.4	0.0
Mar. 8	Cracow	75 Tauri	I	−1.02	−0.86	−0.12	−0.26	+0.29	−0.06	+0.08	+0.20	−0.97	+2.8	+1.5
9	Cracow	119 Tauri	I	−1.06	−0.97	−0.07	−0.09	+0.11	−0.12	0.00	+0.04	−1.00	−0.2	−1.6
Apr. 14	Berlin	80 Virginis	I	−0.97	+0.12	+0.07	−0.21	−0.22	+0.01	−0.34	+0.04	−0.14	−3.9	−5.2
June 17	Dorchester	δ Capricor.	IB	−0.49	+0.43	+0.81	−0.23	+0.84	+0.20	+0.14	−0.56	+0.47	−4.4	−5.0
17	Dorchester	δ Capricor.	E	+0.37	−0.32	+0.87	−0.25	+0.91	+0.19	−0.07	−0.54	−0.35	−0.8	−0.5
Sept. 4	Cracow	o Sagittarii	I	−0.85	+0.92	+0.31	+0.10	+0.33	+0.03	+0.11	−0.40	−0.81	+2.3	+1.2
7	Dorchester	δ Capricor.	I	−0.76	+0.74	+0.52	−0.19	−0.55	+0.14	+0.22	−0.41	−0.35	+1.5	+0.5
Dec. 31	Cracow	311 B. Piscium	I	−0.97	+0.06	−0.01	−0.23	+0.23	+0.02	+0.37	+0.01	−0.88	+3.3	+2.1
1833, Mar. 31	Cracow	8 Leonis	I	−0.58	−0.52	+0.75	−0.40	−0.85	+0.09	−0.15	−0.60	−0.37	+1.2	+0.5
Dec. 26	Berlin	μ Geminor.	IB	−0.66	−0.20	+0.78	+0.05	−0.78	−0.14	+0.04	−0.83	+0.02	−0.8	−1.5
1834, Apr. 13	Cracow	330 B. Tauri	I	−0.63	+0.12	+0.72	+0.19	−0.75	−0.14	+0.11	−0.79	−0.58	+3.2	+2.5
20	Cracow	ν Virginis	I	−0.80	−0.69	+0.11	−0.71	−0.72	+0.11	−0.27	−0.16	−0.44	+2.3	+1.4
July 14	Cape	8 G. Libræ	I	−0.99	−0.86	−0.25	−0.29	−0.38	−0.02	−0.38	+0.19	−0.91	+3.7	+2.7
Aug. 12	Berlin	β Scorpii	I	−0.84	−0.60	+0.54	+0.23	+0.59	−0.26	−0.20	−0.56	−0.81	+1.0	+0.1
12	Berlin	β Scorpii	EB	+0.89	+0.63	+0.49	+0.20	+0.53	−0.01	+0.25	−0.43	+0.85	−4.4	−3.9
30	Cape	κ Geminor.	E	+1.03	+0.19	+0.06	−0.03	−0.06	+0.13	−0.07	−0.05	−0.64	−6.8	−6.1
Oct. 7	Cracow	33 Scorpii	I	−0.98	−0.54	+0.36	+0.01	+0.36	−0.20	−0.06	−0.44	−0.75	+1.3	+0.3
7	Cracow	44 Ophiuchi	I	−1.05	−0.58	−0.02	0.00	−0.02	−0.15	−0.07	−0.07	−0.83	+3.2	+2.1
7	Berlin	44 Ophiuchi	I	−1.04	−0.61	−0.12	0.00	−0.12	−0.12	−0.16	+0.03	−0.82	+1.6	+0.5
8	Berlin	λ Sagittarii	I	−1.00	−0.40	−0.19	+0.05	−0.20	−0.09	−0.07	+0.10	−0.91	+2.7	+1.7
8	Cracow	λ Sagittarii	I	−1.01	−0.37	−0.07	+0.02	−0.07	−0.11	+0.02	−0.02	−0.93	+3.0	+2.0
Nov. 3	Cracow	24 Ophiuchi	I	−1.09	−0.69	−0.13	−0.01	−0.13	−0.17	−0.13	+0.04	−0.41	+1.6	+0.5
1835, Jan. 6	Cracow	35 Ceti	I	−0.67	+0.71	−0.33	−0.58	−0.67	−0.28	+0.25	−0.25	−0.74	+3.5	+2.8
18	Cape	ξ Virginis	IB	−0.76	−0.55	−0.06	−0.70	−0.70	+0.16	−0.35	−0.19	+0.59	−2.0	−2.8
18	Cape	ξ Virginis	E	+0.53	+0.39	−0.09	−0.86	−0.87	+0.43	+0.11	−0.10	−0.42	−0.3	0.0
Apr. 9	Cracow	46 Leonis	I	−1.04	−0.44	+0.04	−0.23	−0.24	−0.07	−0.27	−0.16	−0.61	+2.9	+1.9
June 10	Cracow	θ Ophiuchi	I	−1.06	−0.82	−0.36	+0.07	−0.36	−0.17	−0.08	+0.28	−0.06	+1.5	+0.5

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1835, June 12	Cape	h Sagittarii	IB	−1.01	−0.52	−0.28	−0.24	−0.37	−0.21	+0.07	+0.30	+0.35	+ 2.6	+ 1.6
14	Cape	ε Capricor.	IB	−0.84	−0.11	−0.20	−0.53	+0.57	+0.04	+0.26	−0.41	+0.61	+ 0.3	− 0.5
July 6	Cracow	λ Libræ	I	−0.75	−0.67	−0.73	−0.11	−0.74	+0.07	−0.17	+0.57	−0.53	+ 0.8	+ 0.1
Aug. 6	Cape	51 Sagittarii	I	−0.76	−0.48	−0.51	+0.49	−0.71	−0.18	+0.05	+0.60	−0.35	+ 2.7	+ 2.0
6	Cape	h Sagittarii	I	−1.07	−0.67	−0.06	+0.06	−0.08	−0.19	+0.08	+0.06	−0.50	+ 1.7	+ 0.7
6	Cape	h Sagittarii	EB	+1.02	+0.64	−0.21	+0.21	−0.30	+0.15	−0.09	+0.31	+0.48	−12.1	−11.5
8	Cape	κ Capricor.	IB	−0.87	−0.18	+0.15	−0.52	+0.54	+0.02	+0.28	−0.37	−0.05	− 2.0	− 2.8
29	Cracow	26 Libræ	I	−1.04	−0.96	+0.23	+0.06	+0.24	−0.25	−0.22	−0.25	−0.88	+ 1.7	+ 0.7
Oct. 3	Cracow	69 Aquarii	I	−0.95	−0.02	+0.02	+0.25	−0.25	−0.17	+0.25	+0.02	−0.63	+ 2.1	+ 1.2
29	Cape	κ Capricor.	I	−0.86	−0.31	−0.10	+0.49	−0.50	−0.24	+0.23	+0.25	−0.87	+ 7.1	+ 6.3
Nov. 25	Cracow	35 Capricor.	I	−1.04	−0.44	0.00	+0.01	−0.01	−0.14	+0.19	−0.07	−0.90	+ 4.6	+ 3.7
1836, Feb. 8	Cape	4 G. Libræ	E	+0.93	+0.73	−0.43	−0.16	−0.46	+0.32	+0.32	+0.27	−0.88	+ 6.9	+ 7.4
23	Cracow	14 Tauri	I	−0.86	+0.88	−0.29	−0.01	−0.29	−0.09	+0.28	−0.30	−0.95	+ 2.1	+ 1.3
25	Cracow	118 Tauri	I	−0.87	+0.96	−0.23	+0.12	+0.26	+0.02	+0.12	+0.18	−0.93	+ 4.8	+ 4.0
Apr. 25	Berlin	η Leonis	I	−0.59	+0.22	−0.06	−0.79	−0.79	+0.23	−0.24	−0.46	−0.55	+ 0.5	0.0
25	Berlin	η Leonis	EB	+0.32	−0.12	−0.08	−0.94	−0.94	+0.32	+0.05	−0.52	+0.29	− 2.7	− 2.5
25	Cracow	η Leonis	I	−0.44	+0.17	−0.07	−0.89	−0.89	+0.25	−0.16	−0.51	−0.48	+ 1.4	+ 1.0
May 17	Berlin	118 Tauri	I	−0.43	+0.48	−0.74	−0.46	+0.88	+0.12	+0.07	+0.84	−0.21	+ 0.8	+ 0.4
Aug. 22	Cape	φ Sagittarii	I	−1.11	−1.00	−0.03	+0.04	−0.05	−0.24	+0.50	+0.04	−0.78	− 1.0	− 1.9
22	Cape	φ Sagittarii	EB	+1.16	+1.00	−0.02	+0.03	−0.04	+0.29	−0.34	+0.05	+0.78	− 2.5	− 2.0
Sept. 16	Cape	ρ Ophiuchi	I	−0.90	−0.74	−0.49	+0.21	−0.53	−0.03	−0.23	+0.45	−0.82	+ 4.5	+ 3.7
21	Cape	ε Capricor.	I	−1.07	−0.82	+0.01	+0.16	−0.16	−0.15	+0.52	+0.03	−0.70	+ 0.6	− 0.3
Oct. 21	Cape	77 Piscium	I	−0.75	−0.27	+0.48	+0.49	−0.68	−0.42	+0.25	0.00	−0.44	+ 1.8	+ 1.2
21	Cape	79 Piscium	I	−0.98	−0.36	+0.21	+0.20	−0.29	−0.27	+0.40	−0.04	−0.56	+ 2.3	+ 1.5
1837, Feb. 14	Cracow	112 B. Aurigæ	I	−0.73	+0.65	+0.40	−0.43	−0.59	−0.07	+0.09	−0.62	−0.74	+ 1.4	+ 0.8
17	Berlin	λ Cancri	I	−0.18	+0.19	−0.10	+0.97	+0.98	−0.16	−0.02	+0.84	−0.09	+ 2.1	+ 1.9
Mar. 12	Berlin	62 Tauri	I	−0.75	+0.42	+0.52	−0.33	−0.61	−0.16	+0.16	−0.63	−0.74	+ 2.6	+ 2.0
15	Cracow	47 Geminor.	I	−0.86	+0.91	−0.11	+0.29	+0.31	−0.02	+0.05	+0.25	−0.88	+ 2.7	+ 2.0
May 10	Cracow	λ Cancri	I	−0.69	+0.76	−0.01	+0.65	+0.65	−0.12	−0.07	+0.53	−0.67	+ 0.1	− 0.4
June 6	Cracow	4 Cancri	I	−0.77	+0.82	−0.04	−0.52	−0.52	+0.08	−0.14	−0.51	−0.55	+ 2.1	+ 1.5
16	Cape	δ Scorpii	I	−0.72	−0.29	−0.64	+0.38	−0.74	+0.06	−0.23	+0.62	−0.23	+ 1.2	+ 0.6
July 9	Berlin	η Virginis	EB	+0.92	−0.56	−0.08	−0.04	−0.08	+0.07	+0.44	+0.03	+0.99	− 3.6	− 3.3
Aug. 11	Cape	O.A. 16481	I	−1.07	−0.62	0.00	0.00	0.00	−0.20	−0.14	−0.03	−0.83	− 0.2	− 1.0
18	Berlin	10 Ceti	IB	−1.10	−0.75	+0.03	+0.01	−0.03	−0.23	+0.46	−0.06	+0.51	− 1.2	− 2.0
18	Berlin	10 Ceti	E	+1.09	+0.73	−0.16	−0.06	+0.17	+0.30	−0.45	+0.07	−0.50	− 0.9	− 0.6
Oct. 9	Berlin	143 B. Capricor.	I	−1.07	−0.97	+0.11	+0.22	−0.24	−0.26	+0.31	+0.13	−0.82	+ 1.1	+ 0.3
9	Berlin	143 B. Capricor.	EB	+1.10	+1.00	0.00	+0.01	−0.01	+0.17	+0.24	+0.04	+0.85	− 5.4	− 5.1
Nov. 5	Berlin	35 Capricor.	I	−0.71	−0.66	−0.31	−0.68	+0.75	+0.12	+0.24	−0.55	−0.67	0.0	− 0.5
10	Cracow	54 Ceti	I	−0.80	−0.42	−0.65	+0.07	+0.66	+0.15	+0.34	+0.26	−0.36	+ 0.8	+ 0.2
1838, Jan. 3	Cracow	88 Piscium	I	−1.03	−0.74	−0.15	0.00	+0.15	−0.09	+0.38	+0.01	−1.00	− 0.4	− 1.1
Feb. 4	Cracow	107 B. Aurigæ	I	−0.95	+0.18	−0.02	−0.04	−0.04	−0.06	+0.10	+0.01	−0.86	+ 1.6	+ 0.9
Mar. 1	Cracow	τ Arietis	I	−0.67	−0.26	−0.60	+0.44	+0.74	+0.15	+0.22	+0.57	−0.60	+ 0.1	− 0.4
June 4	Cracow	40 H. Virginis	I	−0.50	+0.35	−0.78	−0.33	+0.85	−0.36	+0.14	−0.48	−0.31	+ 0.6	+ 0.3
July 31	Berlin	65 B. Scorpii	I	−0.94	+0.26	+0.13	−0.19	+0.23	−0.34	−0.09	−0.30	−0.81	+ 4.3	+ 3.6
Aug. 12	Cape	q Tauri	E	+0.74	+0.43	−0.44	+0.53	+0.69	+0.29	−0.17	+0.59	−0.72	− 1.2	− 1.0
Sept. 2	Cracow	κ Capricor.	I	−0.99	−0.70	−0.33	−0.35	+0.48	−0.06	+0.24	−0.32	−0.30	+ 1.2	+ 0.6
8	Berlin	ζ Arietis	IB	−1.05	−0.72	+0.14	−0.13	−0.19	−0.22	+0.31	−0.17	+0.80	− 4.6	− 5.3
Oct. 5	Cape	ε Arietis	E	+0.88	+0.62	−0.45	+0.42	+0.61	+0.04	+0.30	+0.44	−0.38	− 7.8	− 7.6
25	Cracow	A Sagittarii	I	−0.61	−0.26	+0.33	+0.74	−0.80	−0.23	+0.04	+0.73	−0.50	− 0.3	− 0.7
25	Berlin	A Sagittarii	I	−0.26	−0.11	+0.36	+0.90	−0.97	−0.19	+0.03	+0.93	−0.26	+ 0.8	+ 0.6
Nov. 3	Berlin	χ Tauri	IB	−0.64	−0.35	+0.36	−0.72	−0.81	−0.28	+0.11	−0.75	+0.17	+ 0.4	0.0
27	Cracow	171 B. Piscium	I	−0.89	−0.81	−0.57	−0.13	−0.59	+0.10	+0.45	+0.13	−0.63	− 1.0	− 1.6
29	Cape	ε Arietis	I	−0.82	−0.61	−0.47	+0.48	+0.67	+0.04	+0.30	+0.49	−0.32	− 0.1	− 0.6
Dec. 26	Berlin	27 Arietis	I	−0.90	−0.75	+0.43	−0.35	−0.55	−0.36	+0.27	−0.42	−0.71	+ 2.4	+ 1.8
26	Cracow	27 Arietis	I	−1.01	−0.85	+0.27	−0.22	−0.35	−0.31	+0.33	−0.22	−0.80	+ 0.9	+ 0.3

GROUP X—1839–1856.

1839, Apr. 20	Dorchester	γ Cancri	I	−0.81	+0.06	+0.38	+0.41	+0.56	−0.21	−0.21	+0.54	−0.83	−0.3	−0.8
May 2	Berlin	W Sagittarii	E	+0.79	−0.30	−0.06	−0.54	+0.54	+0.02	0.00	−0.55	−0.69	+1.4	+1.5
6	Cape	δ Capricor.	E	+0.98	+0.50	+0.25	+0.15	−0.29	+0.04	−0.40	+0.24	−0.92	0.0	+0.2
24	Cape	α Virginis	I	−0.04	−0.05	+0.87	−0.50	+1.00	−0.43	+0.09	−0.38	−0.03	−2.3	−2.3
24	Cape	α Virginis	EB	+0.36	+0.41	+0.79	−0.46	+0.92	−0.39	+0.28	−0.37	+0.28	0.0	+0.1
June 20	Dorchester	68 Virginis	I	−0.78	−0.85	+0.43	+0.27	−0.50	+0.21	+0.59	+0.21	+0.81	−3.3	−3.8
23	Washington	b Scorpii	I	−0.92	+0.87	+0.04	−0.10	+0.11	−0.04	−0.23	−0.07	−0.51	+0.9	+0.4
23	Dorchester	b Scorpii	I	−0.91	+0.87	−0.04	+0.12	−0.13	+0.02	−0.24	−0.02	−0.51	+1.1	+0.6
24	Cape	α Scorpii	I	−0.81	−0.88	−0.06	+0.47	−0.48	+0.03	−0.18	+0.44	−0.34	+1.5	+1.0
July 1	Dorchester	φ Aquarii	I	−0.97	−0.67	+0.36	+0.03	−0.37	−0.32	+0.40	+0.10	−0.31	+0.2	−0.3

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1839, July 1	Dorchester	φ Aquarii	EB	+0.92	+0.72	+0.06	0.00	−0.06	+0.02	−0.46	+0.01	+0.33	−0.9	−0.8
6	Washington	20 Tauri	IB	−0.33	−0.27	+0.36	−0.89	−0.95	−0.28	+0.04	−0.81	+0.22	+0.4	+0.2
6	Washington	17 Tauri	E	+1.07	+0.90	+0.08	−0.19	−0.21	+0.13	−0.25	−0.18	−0.73	+0.4	+0.6
6	Washington	η Tauri	IB	−1.00	−0.84	+0.15	+0.37	+0.41	−0.08	+0.24	+0.36	+0.68	−0.3	−0.8
6	Washington	20 Tauri	E	+0.67	+0.57	+0.29	−0.73	−0.79	−0.07	−0.17	−0.67	−0.47	−3.9	−3.8
23	Cracow	W Sagittarii	I	−0.60	+0.32	−0.14	−0.77	+0.78	−0.04	+0.01	−0.63	−0.30	+1.1	+0.8
Aug. 17	Cape	A^1 Scorpii	I	−0.90	+0.90	+0.04	−0.13	+0.14	−0.07	−0.24	−0.06	−0.98	+1.6	+1.1
17	Cape	A^2 Scorpii	I	−0.87	+0.87	−0.08	+0.27	−0.29	+0.03	+0.10	+0.27	−0.95	+0.4	−0.1
25	Cracow	φ Aquarii	IB	−1.09	−0.65	−0.09	0.00	+0.09	−0.17	+0.38	−0.02	+0.24	−1.5	−2.1
Sept. 26	Berlin	66 Arietis	E	+0.38	+0.34	−0.35	+0.87	+0.94	+0.29	−0.06	+0.75	−0.24	−1.3	−1.2
26	Washington	20 Tauri	IB	−1.07	−0.95	+0.09	−0.27	−0.28	−0.25	+0.22	−0.22	+0.67	−5.8	−6.4
26	Washington	17 Tauri	E	+0.94	+0.83	−0.17	+0.51	+0.54	+0.28	−0.18	+0.45	−0.59	−0.9	−0.8
26	Washington	16 Tauri	E	+1.11	+0.99	+0.01	−0.05	−0.05	+0.19	−0.24	−0.05	−0.70	+1.1	+1.2
26	Washington	q Tauri	E	+0.94	+0.85	+0.16	−0.51	−0.54	+0.05	−0.22	−0.46	−0.60	+0.8	+0.9
26	Washington	20 Tauri	E	+1.11	+0.99	−0.01	+0.04	+0.04	+0.21	−0.24	+0.02	−0.70	−0.8	−0.7
26	Berlin	20 Tauri	IB	−0.74	−0.66	−0.22	+0.71	+0.74	+0.03	+0.17	+0.65	+0.47	−0.2	−0.6
Oct. 17	Washington	δ Capricor.	I	−0.46	−0.11	+0.83	+0.34	−0.89	−0.39	+0.11	+0.58	−0.39	+1.9	+1.6
18	Berlin	58 Aquarii	I	−0.96	−0.40	+0.40	+0.07	−0.41	−0.33	+0.36	+0.20	−0.66	+3.5	+3.0
18	Cracow	58 Aquarii	I	−1.01	−0.42	+0.17	+0.05	−0.17	−0.22	+0.31	+0.10	−0.69	+1.1	+0.6
19	Cracow	φ Aquarii	I	−1.04	−0.56	−0.35	+0.01	+0.35	−0.06	+0.39	−0.09	−0.56	+0.1	−0.5
19	Cracow	96 Aquarii	I	−1.02	−0.54	−0.43	+0.02	+0.43	−0.03	+0.41	−0.09	−0.54	+2.6	+2.1
Nov. 14	Cracow	ι Aquarii	I	−1.00	−0.26	+0.16	+0.05	−0.16	−0.14	+0.40	+0.05	−0.98	+0.6	+0.1
20	Washington	17 Tauri	I	−1.13	−0.96	+0.06	−0.23	−0.24	−0.29	+0.21	−0.18	−0.08	−8.0	−8.6
20	Dorchester	17 Tauri	I	−1.14	−0.97	+0.06	−0.20	−0.21	−0.29	+0.23	−0.16	−0.08	−7.4	−8.0
20	Dorchester	20 Tauri	I	−0.82	−0.70	+0.18	−0.68	−0.71	−0.32	+0.14	−0.58	−0.06	−4.9	−5.3
20	Washington	η Tauri	I	−0.90	−0.76	−0.16	+0.62	+0.64	−0.05	+0.20	+0.55	−0.06	−6.7	−7.2
20	Washington	η Tauri	EB	+0.60	+0.51	−0.22	+0.83	+0.86	+0.31	−0.09	+0.72	+0.04	−6.2	−6.1
20	Dorchester	η Tauri	I	−0.84	−0.71	+0.17	+0.67	+0.69	−0.02	+0.20	+0.60	−0.06	−1.5	−1.9
Dec. 12	Washington	78 Aquarii	I	−0.97	−0.42	+0.25	0.00	−0.25	−0.24	+0.43	+0.12	−0.96	+5.9	+5.4
1840, Jan. 11	Berlin	δ Piscium	I	−1.02	−0.77	−0.18	+0.11	+0.21	−0.05	+0.47	+0.07	−0.98	+0.1	−0.4
11	Berlin	δ Piscium	EB	+0.90	+0.68	−0.43	+0.28	+0.52	+0.37	−0.33	+0.09	+0.86	−1.7	−1.6
13	Berlin	μ Arietis	I	−0.87	−0.79	−0.27	+0.54	+0.60	+0.04	+0.29	+0.42	−0.74	+0.2	−0.2
13	Berlin	μ Arietis	EB	+0.79	+0.72	−0.30	+0.61	+0.68	+0.34	−0.20	+0.44	+0.67	−8.4	−8.3
13	Cracow	μ Arietis	I	−0.63	−0.57	−0.37	+0.73	+0.82	+0.14	+0.25	+0.56	−0.52	−1.3	−1.6
14	Cracow	q Tauri	I	−0.80	−0.72	−0.13	+0.68	+0.69	−0.02	+0.18	+0.62	−0.58	−1.0	−1.4
14	Cracow	21 Tauri	I	−0.95	−0.85	−0.10	+0.50	+0.51	−0.10	+0.21	+0.60	−0.69	−0.3	−0.8
14	Cracow	22 Tauri	I	−0.86	−0.78	−0.12	+0.62	+0.63	−0.04	+0.19	+0.68	−0.62	−1.8	−2.2
14	Berlin	q Tauri	I	−0.93	−0.83	−0.11	+0.53	+0.54	−0.05	+0.21	+0.48	−0.67	0.0	−0.5
14	Berlin	18 Tauri	I	−0.87	−0.78	+0.12	−0.60	−0.61	−0.28	+0.16	−0.50	−0.63	+1.9	+1.5
14	Berlin	q Tauri	EB	+0.93	+0.84	−0.10	+0.52	+0.53	+0.26	−0.18	+0.45	+0.68	−5.6	−5.5
16	Cracow	406 B. Tauri	I	−1.05	−0.85	−0.08	−0.27	−0.29	−0.25	0.00	−0.25	−0.47	−1.7	−2.2
16	Berlin	406 B. Tauri	I	−0.96	−0.77	−0.14	−0.48	−0.50	−0.15	+0.02	−0.47	−0.44	+0.5	0.0
16	Berlin	136 Tauri	I	−0.29	−0.23	+0.28	+0.92	+0.97	−0.05	0.00	+0.97	−0.13	−0.4	−0.5
16	Berlin	136 Tauri	EB	+0.17	+0.14	+0.29	+0.94	+0.99	+0.02	0.00	+0.98	+0.08	−2.7	−2.7
20	Washington	α Leonis	E	+0.67	+0.05	+0.74	+0.15	+0.76	−0.22	+0.34	+0.37	−0.18	+4.0	+4.1
Feb. 15	Cape	γ Cancri	I	−0.30	−0.12	+0.82	+0.50	+0.96	−0.33	−0.03	+0.75	−0.11	0.0	−0.1
Mar. 15	Berlin	α Leonis	I	−0.96	−0.15	−0.29	−0.05	−0.30	+0.01	−0.41	−0.11	−0.49	+0.6	+0.1
15	Berlin	α Leonis	EB	+0.86	+0.14	−0.50	−0.07	−0.51	+0.30	+0.32	−0.31	+0.44	−0.8	−0.7
23	Cape	α Scorpii	E	+0.81	−0.90	+0.01	+0.44	−0.44	+0.09	+0.14	+0.41	−0.84	−1.3	−1.2
Apr. 11	Cracow	ν Leonis	I	−0.73	−0.19	+0.67	+0.11	+0.68	−0.35	−0.24	+0.42	−0.64	−0.4	−0.7
11	Berlin	ν Leonis	I	−0.65	−0.17	+0.75	+0.12	+0.76	−0.37	−0.20	+0.46	−0.58	+0.5	+0.2
16	Berlin	85 Virginis	IB	−0.85	+0.68	−0.24	+0.33	−0.41	+0.13	−0.39	+0.23	−0.02	−2.4	−2.8
19	Washington	τ Scorpii	IB	−0.50	+0.56	−0.08	−0.82	+0.83	−0.08	−0.06	−0.74	+0.39	−3.3	−3.5
19	Washington	τ Scorpii	E	+0.51	−0.57	−0.08	+0.82	−0.11	+0.08	−0.79	−0.39	−0.39	+2.1	+2.1
May 6	Washington	μ Cancri	I	−0.86	−0.59	+0.48	+0.35	+0.59	−0.26	−0.18	+0.56	−0.74	−0.1	−0.5
8	Berlin	ψ Leonis	I	−1.01	−0.41	−0.03	−0.01	−0.03	−0.12	−0.38	+0.03	−1.00	+0.4	0.0
9	Cape	ρ Leonis	I	−0.94	−0.16	+0.29	−0.01	+0.29	−0.23	−0.39	+0.17	−0.95	+0.2	−0.2
18	Cape	3 Sagittarii	E	+0.86	−0.92	+0.10	+0.25	−0.27	+0.02	0.00	+0.24	−0.46	−1.2	−1.2
19	Cape	φ Sagittarii	IB	−0.90	+0.86	+0.05	+0.07	−0.09	−0.04	+0.11	+0.08	+0.69	−1.7	−2.1
19	Cape	φ Sagittarii	E	+0.90	−0.86	+0.04	+0.06	−0.07	+0.02	−0.49	+0.08	−0.69	+1.5	+1.5
20	Cape	h Sagittarii	IB	−0.91	+0.72	0.00	0.00	0.00	−0.03	+0.21	−0.02	+0.83	−3.3	−3.7
20	Cape	h Sagittarii	E	+0.90	−0.71	+0.11	+0.11	−0.16	+0.01	−0.22	+0.18	−0.82	−6.6	−6.6
22	Cape	ι Capricor.	IB	−0.91	+0.28	−0.26	−0.08	+0.27	+0.02	+0.38	−0.18	+0.95	−1.3	−1.7
22	Cape	ι Capricor.	E	+0.79	−0.24	−0.53	−0.16	+0.55	+0.26	−0.26	−0.40	−0.82	+0.1	+0.1
June 12	Cape	A^1 Scorpii	I	−0.79	+0.85	+0.13	−0.47	+0.47	−0.11	−0.19	−0.34	−0.36	+0.6	+0.3
July 10	Camb., Mass.	τ Scorpii	I	−0.59	+0.62	−0.13	−0.76	+0.77	−0.08	−0.07	−0.69	−0.42	+0.8	+0.6
10	Washington	τ Scorpii	I	−0.46	+0.51	−0.14	−0.85	+0.86	−0.08	−0.05	−0.77	−0.34	+3.4	+3.2
Sept. 3	Cracow	τ Scorpii	I	−0.87	+0.94	−0.06	−0.25	+0.25	−0.05	−0.12	−0.18	−0.97	+0.3	0.0
8	Washington	ι Capricor.	I	−0.81	+0.44	+0.53	+0.10	−0.54	−0.24	+0.26	+0.56	−0.41	+1.4	+1.1
Oct. 13	Washington	η Tauri	E	+0.51	+0.40	+0.04	+0.89	+0.89	+0.25	−0.07	+0.73	−0.26	−0.2	−0.2

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1840, Nov. 2	Washington	ι Capricor.	I	−0.82	+0.52	+0.46	+0.06	−0.47	−0.19	+0.29	+0.44	−0.87	+2.5	+2.2
2	Camb., Mass.	ι Capricor.	I	−0.85	+0.54	+0.41	+0.06	−0.41	−0.18	+0.30	+0.27	−0.90	+3.4	+3.1
2	Washington	ι Capricor.	EB	+0.93	−0.59	+0.04	0.00	−0.04	+0.02	−0.38	−0.04	+0.99	−8.2	−8.2
3	Washington	e Aquarii	I	−0.95	+0.39	−0.05	0.00	−0.05	−0.08	+0.40	+0.07	−0.93	+1.9	+1.6
1841, Feb. 7	Berlin	d Leonis	E	+1.00	+0.47	−0.37	+0.16	−0.40	+0.37	+0.36	−0.17	−0.29	−1.7	−1.7
27	Cracow	7 Tauri	I	−0.55	−0.39	−0.13	−0.84	−0.85	−0.25	+0.09	−0.67	−0.52	+1.8	+1.6
Apr. 28	Cracow	π Cancri	I	−0.69	−0.59	+0.76	−0.01	+0.76	−0.27	−0.18	+0.59	−0.64	+0.1	−0.1
May 23	Berlin	ω Geminor.	I	−1.05	−0.94	+0.29	+0.17	+0.33	−0.24	−0.15	+0.39	−0.63	−2.2	−2.5
June 4	Washington	p Sagittarii	E	+0.88	−0.47	−0.18	−0.20	+0.27	0.00	−0.01	−0.30	−0.15	−2.2	−2.3
30	Cape	α Scorpii	I	−0.87	+0.59	−0.16	−0.30	+0.34	−0.08	−0.11	−0.26	−0.54	+1.6	+1.3
Aug. 1	Washington	19 Capricor.	I	−0.86	+0.92	−0.30	0.00	+0.30	+0.09	+0.35	−0.16	−0.02	+1.6	+1.4
10	Berlin	17 Tauri	IB	−1.04	−0.56	−0.01	−0.03	−0.03	−0.12	+0.17	+0.04	+0.96	−4.0	−4.2
10	Berlin	16 Tauri	IB	−0.78	−0.41	−0.21	−0.63	−0.67	−0.20	+0.21	−0.51	+0.71	−2.7	−2.9
10	Berlin	20 Tauri	IB	−0.74	−0.40	−0.22	−0.66	−0.70	−0.20	+0.12	−0.55	+0.69	+0.2	0.0
10	Berlin	16 Tauri	E	+0.89	+0.48	−0.16	−0.49	−0.52	+0.02	−0.16	−0.50	−0.83	+2.4	+2.3
10	Berlin	17 Tauri	E	+1.03	+0.55	+0.05	+0.14	+0.15	+0.14	−0.17	+0.06	−0.95	+1.1	+0.9
10	Berlin	η Tauri	IB	−0.79	−0.43	+0.21	+0.62	+0.66	+0.02	+0.14	+0.61	+0.73	−1.6	−1.8
10	Berlin	20 Tauri	E	+0.88	+0.47	−0.17	−0.51	−0.54	+0.03	−0.17	−0.50	−0.81	+2.1	+1.9
Sept. 6	Washington	17 Tauri	IB	−0.95	−0.46	+0.12	+0.35	+0.37	−0.03	+0.17	+0.37	+0.90	−4.6	−4.8
6	Washington	q Tauri	IB	−0.66	−0.32	−0.25	−0.72	−0.76	−0.19	+0.10	−0.60	+0.62	−2.5	−2.7
6	Washington	20 Tauri	IB	−0.98	−0.48	−0.09	−0.25	−0.27	−0.13	+0.16	−0.16	+0.93	−3.3	−3.5
6	Washington	17 Tauri	E	+0.78	+0.38	+0.22	+0.61	+0.64	+0.18	−0.13	+0.49	−0.75	+1.2	+1.1
6	Washington	16 Tauri	E	+1.02	+0.50	+0.01	+0.03	+0.03	+0.10	−0.17	−0.04	−0.97	+3.4	+3.2
6	Washington	q Tauri	E	+0.88	+0.44	−0.17	−0.47	−0.50	0.00	−0.16	−0.48	−0.84	+1.8	+1.6
6	Washington	20 Tauri	E	+1.02	+0.50	+0.03	+0.07	+0.07	+0.11	−0.17	−0.01	−0.97	+3.3	+3.1
6	Washington	21 Tauri	E	+0.82	+0.40	−0.21	−0.56	−0.60	−0.03	−0.15	−0.56	−0.79	−9.3	−9.5
6	Washington	22 Tauri	E	+0.91	+0.45	−0.15	−0.42	−0.45	+0.01	−0.17	−0.43	−0.86	+2.4	+2.2
22	Cracow	66 B. Sagittarii	I	−0.59	+0.53	+0.63	+0.44	−0.76	−0.08	+0.05	+0.81	−0.64	−0.6	−0.7
25	Washington	21 Capricor.	I	−0.88	+0.97	+0.19	−0.01	−0.19	−0.06	+0.33	+0.24	−0.78	+1.9	+1.7
Oct. 6	Washington	ε Geminor.	E	+0.77	+0.66	+0.61	+0.32	+0.69	+0.02	+0.09	+0.62	−0.72	+2.4	+2.2
Nov. 27	Washington	17 Tauri	I	−1.06	−0.35	+0.04	+0.09	+0.10	−0.12	+0.18	+0.16	−0.10	−7.5	−7.7
27	Washington	20 Tauri	I	−0.94	−0.32	−0.20	−0.44	−0.49	−0.21	+0.15	−0.34	−0.09	−5.1	−5.3
1842, Jan. 21	Washington	16 Tauri	I	−1.03	−0.29	+0.03	+0.05	+0.06	−0.10	+0.16	+0.13	−0.84	+6.6	+6.4
21	Washington	q Tauri	I	−0.93	−0.26	−0.20	−0.39	−0.43	−0.16	+0.13	−0.29	−0.76	+0.3	+0.1
21	Washington	21 Tauri	I	−0.87	−0.25	−0.25	−0.48	−0.54	−0.17	+0.14	−0.40	−0.71	+0.4	+0.2
21	Washington	22 Tauri	I	−0.94	−0.26	−0.19	−0.36	−0.41	−0.16	+0.15	−0.28	−0.76	+0.6	+0.4
24	Washington	ω Geminor.	I	−0.92	−0.81	−0.12	−0.32	−0.34	−0.01	−0.11	−0.30	−0.29	+7.8	+7.6
Mar. 22	Cracow	o^2 Cancri	I	−1.05	−0.92	−0.30	+0.07	−0.31	−0.09	−0.35	−0.15	−0.68	−3.1	−3.3
22	Cracow	o^1 Cancri	I	−0.87	−0.76	+0.61	−0.14	+0.62	−0.37	−0.23	+0.55	−0.56	−2.5	−2.6
Apr. 12	Camb., Mass.	ε Arietis	I	−0.82	+0.06	+0.20	+0.52	+0.55	+0.08	+0.22	+0.45	−0.43	−1.5	−1.6
May 14	Cracow	63 Geminor.	I	−1.02	−0.77	+0.26	+0.03	+0.26	−0.19	−0.19	+0.32	−0.83	+3.0	+2.9
1843, Jan. 24	Camb., Mass.	σ Scorpii	E	+0.89	+0.76	−0.39	−0.27	+0.48	+0.03	+0.08	−0.52	−0.79	+3.9	+3.5
Mar. 6	Cracow	47 Arietis	I	−0.91	+0.74	−0.02	−0.02	−0.03	0.00	+0.22	+0.07	−0.92	−3.5	−3.5
May 3	Cracow	1 Geminor.	I	−0.95	+0.06	−0.11	−0.01	−0.11	−0.03	−0.10	−0.02	−0.79	−3.0	−3.0
3	Cracow	3 Geminor.	I	−0.74	+0.03	−0.63	−0.05	−0.63	+0.02	−0.07	−0.56	−0.62	−4.2	−4.2
3	Cracow	4 Geminor.	I	−0.91	+0.04	−0.31	−0.02	−0.31	−0.02	−0.08	−0.22	−0.76	−1.3	−1.3
9	Cracow	e Leonis	I	−0.71	−0.62	−0.17	+0.75	−0.77	+0.19	−0.34	−0.03	−0.49	−2.4	−2.4
June 3	Cracow	h Leonis	I	−0.93	−0.61	−0.30	+0.32	−0.44	+0.05	−0.33	−0.20	−0.86	−2.4	−2.4
Sept. 11	Cape	η Piscium	IB	−0.19	+0.21	−0.43	−0.88	−0.98	−0.31	0.00	+0.43	+0.12	+4.1	+4.1
30	Camb., Mass.	39 Sagittarii	I	−0.70	−0.24	+0.69	+0.20	−0.72	−0.18	+0.11	+0.75	−0.70	0.0	0.0
Oct. 6	Berlin	19 Piscium	I	−0.80	+0.74	0.00	−0.49	−0.49	−0.22	+0.31	+0.10	−0.34	+0.7	+0.8
Nov. 2	Cracow	κ Piscium	I	−0.87	+0.71	+0.02	−0.28	−0.28	−0.10	+0.36	+0.13	−0.78	−1.1	−1.0
2	Cracow	9 Piscium	I	−0.85	+0.69	−0.03	+0.35	+0.35	+0.15	+0.41	+0.03	−0.75	−2.2	−2.1
3	Camb., Mass.	45 Piscium	I	−0.90	+0.89	−0.03	−0.14	−0.14	−0.03	+0.36	+0.07	−0.63	−0.2	−0.1
27	Berlin	c^2 Capricor.	I	−0.90	+0.24	−0.18	+0.31	+0.36	+0.06	+0.34	−0.13	−0.87	−2.2	−2.1
1844, Jan. 8	Cape	π Leonis	IB	−1.03	−0.42	+0.01	−0.02	+0.03	−0.13	−0.37	+0.06	+0.69	−3.3	−3.2
8	Cape	π Leonis	E	+1.02	+0.42	−0.05	+0.11	−0.12	+0.16	+0.36	−0.12	−0.68	+1.2	+0.7
31	Cape	2 Geminor.	I	−0.85	+0.50	−0.45	+0.07	−0.45	−0.01	−0.08	−0.48	−0.52	−2.2	−2.1
Feb. 22	Camb., Mass.	104 Piscium	I	−0.86	+0.92	+0.18	+0.24	+0.30	+0.12	+0.29	+0.22	−0.77	+0.6	+0.7
Apr. 26	Cracow	ω Leonis	I	−0.98	−0.12	+0.09	−0.17	+0.19	−0.14	−0.33	+0.22	−0.90	−0.2	−0.1
June 25	Cape	40 H. Virginis	I	−0.40	−0.35	+0.73	+0.58	−0.93	+0.18	−0.15	+0.54	−0.29	−0.2	−0.[illegible]
25	Cape	40 H. Virginis	EB	+0.52	+0.45	+0.70	+0.54	−0.88	+0.32	−0.09	+0.46	+0.38	−1.6	−1.9
1845, Jan. 12	Cracow	κ Piscium	I	−0.98	−0.06	−0.08	−0.23	−0.25	−0.17	+0.35	+0.12	−0.77	−0.2	+0.1
12	Cracow	9 Piscium	I	−0.95	−0.05	+0.11	+0.34	+0.36	+0.05	+0.36	+0.01	−0.74	−1.6	−1.3
Mar. 22	Berlin	e Leonis	I	−0.42	−0.02	−0.36	−0.84	+0.92	+0.33	+0.25	+0.16	−0.02	−5.3	−5.2
Apr. 12	Cracow	68 Orionis	I	−0.89	+0.99	−0.10	+0.07	−0.12	+0.02	−0.07	−0.05	−0.93	−2.5	−2.2
May 16	Berlin	e Leonis	I	−0.59	+0.03	−0.35	−0.73	+0.81	−0.33	−0.16	+0.17	−0.48	−0.2	0.0
16	Berlin	e Leonis	EB	+0.76	−0.04	−0.29	−0.58	+0.64	−0.19	+0.31	+0.02	+0.62	+1.3	+0.8
20	Berlin	25 Libræ	I	−0.94	−0.65	−0.54	−0.07	+0.54	−0.25	−0.13	−0.34	−0.10	−1.0	−0.7
20	Cracow	25 Libræ	I	−0.96	−0.66	−0.50	−0.07	+0.51	−0.25	+0.14	−0.31	−0.10	−0.4	−0.1

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1845, June 16	Berlin	10 Libræ	I	−0.71	−0.44	+0.75	+0.14	−0.76	+0.04	+0.14	+0.58	−0.38	−0.4	−0.1
July 16	Camb., Mass.	58 Ophiuchi	I	−1.09	−0.94	+0.25	−0.15	−0.29	−0.23	+0.05	+0.37	−0.47	−0.2	+0.2
17	Camb., Mass.	29 Sagittarii	I	−1.09	−0.95	−0.22	+0.23	+0.32	−0.19	+0.14	−0.24	−0.26	+1.0	+1.4
Sept. 13	Cracow	c^1 Capricor.	I	−1.09	−0.82	+0.01	+0.13	+0.13	−0.13	+0.31	−0.02	−0.52	−3.3	−2.9
22	Camb., Mass.	57 Orionis	E	+0.83	−0.86	−0.31	+0.23	−0.39	−0.01	+0.03	−0.45	−0.92	+3.1	+2.4
22	Camb., Mass.	64 Orionis	E	+0.89	−0.93	+0.11	+0.09	+0.14	−0.05	+0.05	+0.07	−0.98	+3.8	+3.1
Oct. 20	Berlin	71 Orionis	IB	−0.86	+0.89	−0.23	−0.21	−0.31	+0.03	−0.05	−0.26	+0.82	−5.1	−4.8
20	Berlin	71 Orionis	E	+0.85	−0.91	−0.25	−0.24	−0.34	−0.03	+0.05	−0.28	−0.83	+3.0	+2.3
Nov. 6	Berlin	ν Aquarii	I	−0.43	−0.39	+0.03	−0.91	−0.92	−0.30	+0.08	+0.68	−0.41	+1.6	+1.8
6	Berlin	ν Aquarii	EB	+0.65	+0.58	+0.02	−0.79	−0.79	−0.14	−0.20	+0.53	+0.62	0.0	−0.5
6	Cracow	ν Aquarii	I	−0.73	−0.63	+0.03	−0.73	−0.73	−0.29	+0.16	+0.57	−0.68	+0.4	+0.7
9	Cracow	22 Piscium	I	−1.02	−0.50	−0.05	−0.05	−0.07	−0.11	+0.34	+0.07	−0.84	−1.1	−0.7
9	Berlin	22 Piscium	I	−0.98	−0.46	−0.19	−0.21	−0.28	−0.17	+0.31	+0.07	−0.81	+0.4	+0.8
9	Berlin	22 Piscium	EB	+1.02	+0.47	−0.07	−0.08	−0.11	+0.05	−0.34	−0.05	+0.83	−1.0	−1.8
10	Camb., Mass.	δ Piscium	I	−0.94	−0.26	+0.29	+0.20	+0.35	+0.06	+0.30	+0.12	−0.64	−1.0	−0.6
Dec. 6	Camb., Mass.	22 Piscium	I	−0.96	−0.51	+0.22	+0.24	+0.33	+0.04	+0.35	+0.08	−0.95	−1.4	−1.0
1846, Feb. 6	Camb., Mass.	71 Orionis	I	−0.88	+0.81	+0.15	−0.18	+0.24	−0.01	−0.07	+0.29	−0.73	−1.9	−1.5
20	Camb., Mass.	16 Sagittarii	E	+1.03	+0.85	−0.22	+0.27	+0.35	+0.19	−0.08	−0.41	−0.77	+2.1	+1.3
Mar. 31	Camb., Mass.	97 Tauri	I	−0.84	+0.42	+0.39	−0.26	+0.47	+0.01	+0.05	+0.48	−0.74	−3.6	−3.2
May 3	Camb., Mass.	ω Leonis	I	−0.57	+0.62	+0.17	+0.76	−0.77	+0.22	−0.21	−0.42	−0.62	−1.0	−0.7
4	Cracow	14 Sextantis	I	−0.90	+0.92	+0.07	+0.16	−0.18	+0.08	−0.31	−0.05	−0.93	−2.0	−1.6
June 29	Camb., Mass.	69 Leonis	I	−0.79	+0.73	−0.33	−0.36	+0.49	−0.13	−0.28	+0.19	−0.84	−0.8	−0.4
Aug. 14	Berlin	68 Tauri	E	+0.70	−0.07	+0.56	−0.38	+0.68	+0.07	−0.06	+0.58	−0.72	+3.6	+3.0
Sept. 14	Berlin	68 Geminor.	E	+0.89	−0.73	+0.04	−0.23	+0.23	−0.04	+0.16	+0.23	−0.89	+2.7	+1.9
Nov. 22	Berlin	ρ Sagittarii	I	−1.05	−0.72	−0.03	+0.18	+0.18	−0.12	+0.14	−0.15	−0.73	−1.4	−0.8
1847, Jan. 3	Camb., Mass.	65 Cancri	E	+0.87	−0.72	+0.09	+0.32	−0.33	+0.06	−0.01	−0.25	−0.36	+1.0	+0.2
5	Camb., Mass.	34 Sextantis	E	+0.86	−1.00	−0.22	−0.22	+0.30	−0.14	−0.05	+0.07	−0.82	+0.8	0.0
25	Camb., Mass.	δ Tauri	I	−0.60	−0.16	+0.59	−0.53	+0.80	+0.07	−0.05	+0.73	−0.63	−1.2	−0.8
25	Camb., Mass.	68 Tauri	I	−0.88	−0.17	−0.34	+0.32	−0.47	−0.08	−0.06	−0.40	−0.75	−0.4	+0.1
25	Greenwich	180 B. Tauri	I	−0.75	−0.16	−0.51	+0.42	−0.66	−0.13	+0.10	−0.56	−0.70	+0.8	+1.3
25	Camb., Eng.	180 B. Tauri	I	−0.72	−0.15	−0.54	+0.43	−0.69	−0.12	+0.09	−0.58	−0.76	−0.4	0.0
Feb. 24	Camb., Eng.	u Geminor.	I	−0.75	+0.26	−0.13	+0.58	−0.60	+0.05	−0.06	−0.57	−0.72	−1.9	−1.4
Mar. 24	Greenwich	λ Geminor.	I	−0.64	+0.27	−0.05	+0.73	−0.73	+0.09	−0.09	−0.68	−0.67	−0.5	−0.1
24	Greenwich	λ Geminor.	EB	+0.49	−0.21	−0.06	+0.85	−0.85	+0.09	+0.06	−0.82	+0.52	+0.6	+0.2
26	Greenwich	κ Cancri	I	−0.90	+0.80	+0.02	+0.04	−0.04	+0.06	−0.24	+0.01	−0.81	−0.5	+0.1
Apr. 22	Greenwich	A^2 Cancri	I	−0.93	+0.63	+0.15	+0.42	−0.44	+0.12	−0.21	−0.32	−0.90	+5.3	+5.9
22	Camb., Eng.	A^2 Cancri	I	−0.82	+0.62	+0.15	+0.44	−0.46	+0.12	−0.21	−0.33	−0.87	−1.3	−0.7
25	Cape	d Leonis	I	−0.85	+0.93	+0.28	+0.20	−0.34	+0.13	−0.31	−0.05	−0.70	−2.0	−1.4
May 23	Greenwich	υ Leonis	I	−0.90	+1.00	−0.08	−0.04	+0.09	+0.02	−0.31	+0.05	−0.93	−0.7	0.0
23	Camb., Eng.	υ Leonis	I	−0.89	+1.00	−0.06	−0.03	+0.07	+0.03	−0.31	+0.05	−0.93	−1.0	−0.3
28	Camb., Eng.	ζ Libræ	I	−0.89	+0.41	+0.26	−0.20	−0.33	+0.06	−0.18	+0.29	−0.15	+1.3	+2.0
June 1	Camb., Eng.	ρ Sagittarii	IB	−1.01	−0.45	0.00	−0.19	−0.19	−0.11	+0.12	+0.20	+0.65	−8.7	−7.9
1	Camb., Eng.	ρ Sagittarii	E	+1.01	−0.45	0.00	−0.18	−0.18	+0.06	−0.12	+0.15	−0.65	+1.0	+0.1
1	Greenwich	ρ Sagittarii	E	+1.02	+0.46	0.00	−0.17	−0.17	+0.07	−0.13	+0.14	−0.65	+2.0	+1.1
17	Cape	o Leonis	I	−0.92	+0.77	−0.05	−0.06	+0.08	0.00	−0.26	+0.11	−0.83	−2.0	−1.3
Sept. 16	Camb., Mass.	29 Ophiuchi	I	−0.90	+0.31	−0.14	+0.28	+0.32	−0.03	+0.03	−0.28	−0.91	−2.0	−1.2
Oct. 18	Cape	ν Aquarii	I	−0.97	−0.61	+0.23	+0.32	+0.39	−0.02	+0.23	−0.17	−0.81	−2.2	−1.3
Nov. 18	Camb., Eng.	44 Piscium	I	−0.65	−0.59	+0.81	+0.03	+0.81	+0.16	+0.23	+0.07	−0.39	−4.3	−3.7
1848, Jan. 12	Camb., Mass.	80 Piscium	I	−1.06	−0.87	−0.13	+0.03	−0.13	−0.15	−0.08	−0.06	−0.87	−2.0	−0.9
16	Greenwich	α Tauri	EB	+0.72	+0.49	+0.31	−0.66	+0.73	+0.17	−0.08	+0.68	+0.53	+1.3	+0.7
16	Camb., Eng.	α Tauri	I	−0.86	−0.58	+0.24	−0.53	+0.58	−0.02	+0.10	+0.52	−0.61	−2.8	−1.9
16	Camb., Eng.	α Tauri	EB	+0.74	+0.50	+0.30	−0.65	+0.71	+0.15	−0.08	+0.67	+0.56	+1.0	+0.3
Feb. 12	Camb., Mass.	α Tauri	I	−0.54	−0.50	+0.37	−0.78	+0.86	+0.06	−0.02	+0.80	−0.63	−1.9	−1.4
12	Camb., Mass.	α Tauri	EB	+0.33	+0.12	+0.40	−0.86	+0.95	+0.15	+0.01	+0.88	+0.16	+0.9	+0.6
15	Cracow	λ Geminor.	I	−0.84	−0.20	−0.13	−0.54	+0.55	−0.09	−0.08	+0.54	−0.60	−2.7	−1.9
Mar. 11	Camb., Mass.	111 Tauri	I	−0.68	−0.48	+0.15	−0.74	+0.74	−0.01	−0.01	+0.71	−0.71	−3.8	−3.1
21	Camb., Eng.	m Virginis	IB	−0.64	+0.75	+0.60	−0.27	−0.66	+0.26	−0.24	+0.29	+0.28	−2.1	−1.4
Apr. 12	Camb., Mass.	o Leonis	I	−0.94	+0.25	−0.11	−0.09	+0.14	−0.03	+0.06	+0.08	−0.82	−3.9	−2.9
15	Cape	B. A. C. 4019	I	−0.52	+0.45	−0.82	−0.04	+0.82	−0.24	−0.12	+0.82	−0.30	−0.2	+0.3
May 4	Camb., Mass.	α Tauri	I	....	−0.70	+0.24	−0.66	+0.70	−0.05	−0.03	+0.66	−0.30	−2.3	−1.5
7	Greenwich	68 Geminor.	I	−0.62	−0.19	−0.30	−0.74	+0.80	−0.14	−0.07	+0.76	−0.50	+0.2	+0.9
9	Cracow	35 Leonis	I	−0.26	+0.04	+0.72	+0.64	−0.96	+0.20	−0.08	−0.68	−0.26	−0.5	−0.2
17	Cape	γ Libræ	I	−0.86	+0.90	−0.17	+0.24	+0.30	−0.02	−0.17	−0.22	−0.05	−1.5	−0.6
June 6	Greenwich	10 Sextantis	EB	+0.93	−0.22	−0.24	−0.16	+0.29	−0.05	+0.26	−0.12	+0.86	+7.0	+6.2
8	Cape	τ Leonis	I	−0.65	+0.44	−0.70	−0.08	+0.70	−0.20	−0.19	+0.13	−0.71	−1.8	−1.1
13	Camb., Eng.	30 Libræ	I	−0.78	+0.86	+0.26	−0.38	−0.46	+0.16	+0.20	+0.36	−0.47	−0.7	+0.1
July 11	Camb., Eng.	θ Libræ	I	−0.34	+0.02	−0.40	+0.83	+0.92	−0.14	−0.26	−0.78	−0.32	−2.1	−1.7
11	Greenwich	θ Libræ	I	−0.31	+0.02	−0.41	+0.85	+0.94	−0.15	−0.05	−0.79	−0.26	−0.2	+0.1
15	Camb., Eng.	246 B. Sagittarii	I	−0.67	+0.57	+0.30	+0.66	+0.72	+0.06	+0.07	−0.70	−0.01	−0.4	+0.3
Aug. 7	Camb., Mass.	η Libræ	I	−0.72	+0.89	+0.28	−0.52	−0.59	+0.15	+0.05	+0.48	−0.91	−2.3	−1.5

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1848, Aug. 21	Camb., Eng.	γ Tauri	IB	−1.00	+0.48	−0.12	+0.36	−0.38	−0.18	+0.14	−0.36	+0.93	−9.0	−7.9
21	Camb., Eng.	γ Tauri	E	+1.05	−0.50	−0.08	+0.24	−0.25	+0.09	−0.15	−0.21	−0.96	+1.8	+0.9
21	Greenwich	γ Tauri	E	+1.03	−0.50	+0.07	−0.23	−0.24	+0.07	−0.16	−0.19	−0.97	+1.1	+0.2
Sept. 15	Greenwich	ξ¹ Ceti	E	+0.77	+0.66	+0.56	−0.52	+0.77	+0.37	−0.14	+0.42	−0.41	+4.4	+3.7
15	Camb., Mass.	ξ¹ Ceti	E	+1.12	−0.87	+0.06	−0.05	+0.07	+0.19	+0.07	+0.06	+0.54	+1.8	+0.8
Oct. 28	Camb., Mass.	η Libræ	I	−0.74	+0.94	+0.23	−0.52	−0.57	+0.16	+0.04	+0.44	−0.31	−1.3	−0.5
Nov. 9	Camb., Eng.	ξ¹ Ceti	I	−0.72	−0.58	+0.55	+0.56	+0.78	+0.09	+0.20	+0.40	−0.18	−5.1	−4.3
9	Camb., Eng.	ξ¹ Ceti	EB	+0.58	+0.46	+0.61	−0.63	+0.87	+0.34	−0.10	+0.47	+0.17	−5.0	−5.6
Dec. 4	Camb., Eng.	η Piscium	I	−0.62	−0.34	−0.79	+0.10	−0.80	+0.20	−0.23	0.00	−0.52	+7.4	+8.1
1849, Jan. 3	Camb., Eng.	ξ¹ Ceti	I	−0.66	−0.56	−0.52	+0.59	−0.79	−0.29	+0.14	−0.44	−0.54	+4.1	+4.9
3	Cracow	64 Ceti	I	−1.07	−0.90	−0.04	+0.04	−0.06	−0.14	+0.28	−0.07	−0.92	−2.9	−1.6
3	Cracow	ξ² Ceti	I	−0.99	−0.83	−0.28	+0.29	−0.41	−0.22	+0.22	−0.28	−0.84	−1.7	−0.5
5	Camb., Mass.	γ Tauri	I	−1.11	−0.99	+0.04	−0.17	+0.17	−0.14	−0.02	+0.15	−0.64	−0.7	+0.6
5	Camb., Mass.	γ Tauri	EB	+1.04	+0.83	+0.08	−0.36	+0.37	+0.22	+0.02	+0.33	+0.54	−8.2	−9.2
5	Camb., Mass.	75 Tauri	I	−1.02	−0.81	−0.07	+0.42	−0.43	−0.21	−0.01	−0.41	−0.52	−0.6	+0.6
5	Greenwich	θ¹ Tauri	I	−1.02	−0.90	+0.06	−0.42	+0.42	−0.10	+0.14	+0.36	−0.58	−1.0	+0.2
5	Greenwich	θ² Tauri	I	−0.75	−0.66	+0.10	−0.74	+0.75	−0.01	+0.12	+0.66	−0.43	−1.2	−0.3
5	Greenwich	264 B. Tauri	I	−1.06	−0.94	0.00	+0.30	−0.30	−0.20	+0.14	−0.30	−0.61	+1.1	+2.2
5	Greenwich	θ¹ Tauri	EB	+1.08	+0.95	+0.04	−0.28	+0.28	+0.21	−0.14	−0.48	+0.60	−7.4	−8.5
5	Greenwich	269 B. Tauri	I	−1.11	−0.95	−0.02	+0.13	−0.13	−0.19	+0.15	−0.14	−0.63	+6.1	+7.4
6	Camb., Mass.	111 Tauri	I	−1.02	−0.88	−0.02	−0.45	+0.45	−0.13	+0.02	+0.39	−0.46	−2.3	−1.1
Feb. 9	Camb., Mass.	5 Virginis	IB	−0.93	+0.17	−0.34	+0.06	+0.35	−0.15	+0.07	+0.02	+0.35	−4.4	−3.3
13	Cape	ξ Libræ	E	+0.88	−0.88	+0.12	−0.21	−0.24	+0.03	+0.24	+0.18	−0.94	+3.1	+2.2
27	Greenwich	85 Ceti	I	−0.93	−0.79	−0.27	+0.45	−0.52	−0.46	+0.36	−0.48	−0.77	−1.1	0.0
Mar. 2	Camb., Eng.	130 Tauri	I	−0.99	−0.88	+0.08	+0.37	−0.38	−0.13	+0.05	−0.40	−0.85	+3.1	+4.3
3	Camb., Eng.	26 Geminor.	I	−0.95	−0.77	−0.19	−0.37	+0.41	−0.09	−0.01	+0.38	−0.76	−0.6	+0.5
8	Camb., Eng.	82 Leonis	IB	−0.28	+0.03	−0.96	+0.10	+0.96	−0.30	−0.04	+0.18	+0.03	−1.3	−1.0
11	Camb., Mass.	95 Virginis	E	+0.76	−0.44	+0.37	−0.43	−0.57	+0.15	−0.03	+0.32	−0.34	+0.4	−0.4
29	Greenwich	111 Tauri	I	−1.07	−0.98	−0.03	−0.16	+0.16	−0.13	−0.01	+0.23	−0.93	−1.6	−0.3
29	Greenwich	111 Tauri	EB	+1.07	+0.98	−0.03	−0.16	+0.16	+0.14	−0.07	+0.17	+0.93	−1.6	−2.7
Apr. 5	Cracow	β Virginis	I	−0.94	+0.14	+0.24	−0.06	−0.24	+0.06	−0.31	−0.04	−0.42	−1.9	−0.8
6	Cape	γ Virg. (N)	I	−0.91	+0.39	−0.27	+0.14	+0.30	−0.11	−0.28	−0.09	−0.20	+3.1	+4.2
6	Cape	γ Virg. (S)	I	−0.91	+0.39	−0.27	+0.14	+0.30	−0.11	−0.28	−0.09	−0.20	−1.4	−0.3
May 2	Camb., Mass.	5 Virginis	I	−0.95	+0.10	−0.16	+0.04	+0.16	−0.07	+0.08	0.00	−0.66	−1.6	−0.5
July 12	Greenwich	f Piscium	E	+0.71	+0.38	−0.52	+0.50	−0.72	−0.22	−0.35	−0.16	−0.69	+1.0	+0.3
13	Cape	ξ¹ Ceti	E	+0.33	+0.23	+0.53	−0.79	+0.95	+0.26	−0.04	+0.52	−0.30	−3.0	−3.3
16.	Camb., Mass.	α Tauri	I	−1.06	−0.84	+0.01	+0.34	−0.34	+0.16	−0.23	−0.36	+0.65	−0.5	+0.8
Sept. 5	Greenwich	ν Piscium	IB	−0.58	−0.29	−0.50	+0.66	−0.83	−0.30	+0.13	−0.36	+0.55	−4.7	−4.0
5	Greenwich	ν Piscium	E	+0.83	+0.42	−0.36	+0.48	−0.60	−0.05	−0.12	−0.25	−0.55	+1.0	+0.2
5	Camb., Eng.	ν Piscium	IB	−0.56	−0.28	−0.50	+0.67	−0.84	−0.31	+0.13	−0.37	+0.41	−2.1	−1.4
5	Camb., Eng.	ν Piscium	E	+0.69	+0.34	−0.45	+0.60	−0.75	−0.17	−0.25	−0.26	−0.43	+2.3	+1.6
8	Camb., Eng.	71 Tauri	E	+0.99	+0.87	+0.03	+0.38	−0.38	+0.05	−0.18	−0.29	−0.91	+0.9	−0.1
8	Camb., Eng.	θ² Tauri	IB	−0.42	−0.38	+0.08	+0.92	−0.92	−0.20	+0.05	−0.85	+0.39	−1.5	−1.0
8	Camb., Eng.	81 Tauri	IB	−1.06	−0.94	−0.01	−0.10	+0.10	−0.10	+0.18	+0.06	+0.98	−6.0	−4.7
8	Camb., Eng.	80 Tauri	E	+1.01	+0.88	−0.03	−0.35	+0.35	+0.18	−0.15	+0.37	−0.92	+1.9	+0.9
8	Camb., Eng.	81 Tauri	E	+1.03	+0.90	−0.02	−0.27	+0.27	+0.16	−0.16	+0.29	−0.94	+5.4	+4.3
25	Cape	ρ Sagittarii	I	−0.59	+0.61	−0.55	−0.53	−0.76	−0.03	+0.03	+0.70	−0.62	−0.3	+0.4
25	Cape	ρ Sagittarii	E	+0.77	−0.80	−0.39	−0.37	−0.54	−0.05	−0.06	+0.55	+0.81	−3.9	−4.7
27	Camb., Mass.	29 Capricor.	I	−0.64	+0.57	+0.71	+0.21	+0.74	+0.15	−0.07	−0.54	−0.64	+4.4	+5.2
Oct. 3	Cape	ξ¹ Ceti	E	+0.78	+0.41	+0.34	−0.60	+0.69	+0.30	−0.18	+0.42	−0.26	0.0	−0.8
25	Cracow	73 B. Aquarii	I	−0.84	+0.57	−0.43	−0.09	−0.44	−0.08	+0.18	+0.24	−0.86	+0.5	+1.5
Nov. 22	Camb., Mass.	40 Aquarii	I	−0.90	+0.50	+0.27	0.00	+0.27	+0.07	−0.09	−0.19	−1.00	+3.2	+4.3
23	Cape	λ Aquarii	I	−0.85	+0.30	−0.45	+0.09	−0.45	−0.15	+0.22	+0.15	−0.86	−0.2	+0.9
23	Cape	λ Aquarii	EB	+0.95	−0.34	−0.12	+0.03	−0.12	−0.01	−0.29	+0.05	+0.96	−2.9	−3.9
26	Cape	μ Piscium	I	−0.64	−0.25	−0.44	+0.59	−0.74	−0.24	+0.17	−0.28	−0.41	−1.3	−0.6
29	Camb., Mass.	θ² Tauri	I	−1.00	−0.85	−0.06	−0.48	+0.49	−0.09	+0.02	+0.42	+0.01	−4.6	−3.3
29	Camb., Mass.	α Tauri	I	−1.15	−0.78	+0.01	+0.05	−0.05	−0.22	+0.02	−0.09	+0.01	−2.3	−0.8
Dec. 1	Cape	ν Geminor.	E	+0.64	+0.73	+0.40	+0.54	−0.68	−0.06	−0.02	−0.73	−0.28	+1.2	+0.5
1850, Jan. 17	Cape	φ Aquarii	I	−0.77	+0.30	−0.54	+0.20	−0.58	−0.17	+0.22	+0.12	−0.66	−1.2	−0.2
23	Cape	64 Tauri	I	−0.54	−0.43	+0.15	+0.86	−0.87	−0.24	+0.07	−0.78	−0.38	−2.0	−1.3
23	Camb., Mass.	θ² Tauri	I	−1.10	−0.86	−0.01	−0.03	+0.04	−0.15	+0.02	+0.01	−0.76	−3.2	−1.8
23	Camb., Mass.	α Tauri	I	−1.02	−0.75	+0.08	+0.36	−0.37	−0.20	+0.01	−0.39	−0.66	−2.6	−1.3
23	Camb., Mass.	α Tauri	EB	+1.08	+0.87	+0.04	+0.19	−0.19	+0.12	−0.02	−0.13	+0.77	+1.3	+0.1
23	Camb., Eng.	γ Tauri	I	−0.63	−0.50	+0.14	+0.80	−0.82	+0.07	−0.13	−0.53	−0.43	−1.0	−0.2
23	Camb., Eng.	γ Tauri	EB	+1.08	+0.87	+0.01	+0.06	−0.06	+0.12	+0.08	−0.23	+0.77	+2.3	+1.1
23	Camb., Eng.	θ¹ Tauri	I	−1.08	−0.86	+0.03	+0.12	−0.12	−0.12	−0.19	+0.18	−0.76	−2.3	−0.9
23	Greenwich	α Tauri	I	−0.62	−0.49	+0.18	+0.81	−0.83	−0.23	+0.08	−0.79	−0.43	−1.8	−1.0
23	Greenwich	α Tauri	EB	+0.49	+0.39	+0.20	+0.86	−0.89	−0.09	−0.09	−0.81	+0.35	+2.0	+1.5
25	Cape	ν Geminor.	I	−1.05	−0.92	+0.24	+0.29	−0.38	−0.20	+0.02	−0.34	−0.46	−2.4	−1.0
25	Cape	ν Geminor.	EB	+1.09	+0.95	+0.19	+0.23	−0.30	+0.20	−0.03	−0.33	+0.47	+1.5	+0.3

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1850, Feb. 21	Cape	64 Orionis	I	−0.59	−0.51	−0.49	−0.69	+0.85	−0.04	+0.05	+0.82	−0.46	−2.6	−1.8
21	Cape	χ^2 Orionis	I	−0.69	−0.61	+0.45	+0.63	−0.77	−0.15	+0.03	−0.79	−0.55	−2.1	−1.2
26	Camb., Mass.	σ Leonis	I	−1.10	−0.54	+0.10	−0.04	−0.11	−0.13	+0.08	−0.12	+0.07	−3.4	−2.0
Mar. 23	Greenwich	o^1 Cancri	I	−1.09	−0.93	−0.03	−0.01	+0.03	−0.15	−0.18	−0.02	−0.78	−3.1	−1.7
24	Camb., Mass.	27 Leonis	I	−0.50	−0.60	+0.89	−0.04	−0.89	+0.14	+0.06	−0.53	−0.46	0.0	+0.7
Apr. 15	Cracow	264 B. Tauri	I	−0.80	−0.56	−0.18	−0.65	+0.67	−0.01	+0.15	+0.58	−0.55	−2.0	−0.9
15	Camb., Eng.	α Tauri	EB	+1.07	+0.75	+0.01	+0.04	−0.04	+0.12	−0.18	+0.03	+0.74	+4.8	+3.6
15	Camb., Mass.	α Tauri	I	−0.87	−0.67	−0.17	−0.57	+0.58	0.00	+0.03	+0.50	−0.59	−1.7	−0.5
15	Camb., Mass.	α Tauri	EB	+0.73	+0.42	−0.22	−0.70	+0.74	+0.22	−0.02	+0.73	+0.37	+0.7	−0.1
15	Cracow	α Tauri	I	−1.06	−0.77	+0.01	+0.02	−0.02	−0.13	+0.19	−0.08	−0.74	−2.5	−1.1
16	Cracow	120 Tauri	I	−0.65	−0.46	+0.42	+0.68	−0.80	−0.14	+0.05	−0.82	−0.52	+0.1	+1.0
17	Cape	ν Geminor.	I	−0.84	−0.77	−0.42	−0.43	+0.60	−0.08	+0.02	+0.56	−0.75	−0.5	+0.6
18	Camb., Mass.	g Geminor.	I	−0.83	−0.87	+0.57	+0.30	−0.64	−0.05	−0.07	−0.66	−0.86	0.0	+1.1
21	Cracow	ρ Leonis	I	−0.64	−0.52	−0.77	+0.18	+0.80	−0.29	−0.13	+0.29	−0.51	−1.0	−0.1
22	Cracow	σ Leonis	I	−0.97	−0.60	+0.34	−0.18	−0.38	+0.03	−0.31	−0.17	−0.69	−0.9	+0.5
May 19	Camb., Mass.	σ Leonis	I	−0.94	−0.45	−0.38	+0.20	+0.43	−0.23	+0.06	+0.19	−0.64	−2.4	−1.1
19	Camb., Mass.	σ Leonis	EB	+1.04	+0.66	−0.12	+0.07	+0.14	+0.07	−0.07	+0.11	+0.94	−1.6	−2.8
28	Camb., Eng.	36 Sagittarii	IB	−0.90	+0.96	−0.02	−0.01	−0.02	+0.03	+0.01	−0.04	+0.53	−2.7	−1.5
28	Camb., Eng.	36 Sagittarii	E	+0.89	−0.95	−0.12	−0.09	−0.15	−0.03	−0.01	+0.21	−0.52	+0.1	−1.0
June 1	Greenwich	42 Aquarii	E	+0.90	−0.79	+0.12	−0.03	+0.12	0.00	−0.26	+0.01	−0.98	+2.4	+1.3
13	Camb., Mass.	82 Cancri	I	−1.04	−0.78	−0.34	−0.02	+0.34	−0.22	+0.07	+0.19	−0.58	−3.8	−2.3
14	Camb., Mass.	α Leonis	I	−1.08	−0.81	−0.11	+0.02	+0.11	−0.18	+0.07	+0.02	−0.77	−2.6	−1.1
14	Camb., Mass.	α Leonis	EB	+1.08	+0.79	+0.16	−0.03	−0.17	+0.21	+0.12	−0.05	+0.75	+2.1	+0.8
July 21	Camb., Eng.	21 Sagittarii	I	−0.53	+0.50	−0.60	−0.53	−0.80	+0.06	−0.02	+0.76	−0.33	+0.3	+1.0
21	Camb., Eng.	21 Sagittarii	EB	+0.54	−0.50	−0.60	−0.53	−0.80	+0.01	+0.02	+0.84	+0.28	−2.3	−2.9
24	Camb., Eng.	21 Capricor.	I	−0.85	+0.95	+0.29	+0.02	+0.29	+0.09	+0.18	−0.29	−0.13	−2.9	−1.7
30	Cape	ν Piscium	E	+0.91	−0.05	+0.13	−0.31	+0.34	+0.14	−0.29	+0.22	−0.93	−0.5	−1.6
Aug. 2	Camb., Eng.	α Tauri	IB	−1.05	−0.64	−0.09	−0.19	+0.21	−0.09	+0.19	+0.13	+0.82	+0.1	+1.6
8	Camb., Mass.	α Leonis	I	−0.35	+0.04	−0.93	+0.21	+0.95	−0.30	0.00	+0.49	0.00	−1.5	−1.0
8	Camb., Mass.	α Leonis	EB	+0.59	+0.72	−0.84	+0.19	+0.86	−0.10	−0.07	+0.48	+0.09	+0.8	+0.1
14	Cracow	γ Libræ	I	−0.96	+0.21	−0.02	−0.03	−0.03	+0.01	−0.26	+0.06	−0.99	+0.3	+1.6
14	Greenwich	γ Libræ	I	−0.94	+0.21	−0.03	−0.14	−0.14	+0.03	−0.26	+0.10	−0.98	+0.4	+1.7
14	Camb., Eng.	γ Libræ	I	−0.97	+0.21	−0.03	−0.19	−0.19	0.00	−0.25	+0.21	−0.98	+0.8	+2.2
14	Camb., Eng.	γ Libræ	EB	+0.94	−0.21	−0.03	−0.19	−0.19	+0.17	+0.25	+0.21	+0.98	−3.7	−4.8
27	Camb., Mass.	73 Ceti	IB	−0.93	−0.07	−0.05	+0.31	−0.32	−0.14	−0.02	−0.26	+0.72	−1.7	−0.4
27	Camb., Mass.	73 Ceti	E	+0.98	+0.09	−0.01	+0.10	−0.10	+0.02	+0.01	+0.02	−0.88	+1.0	−0.2
30	Camb., Mass.	α Tauri	IB	−0.85	−0.56	−0.24	−0.52	+0.57	+0.02	+0.03	+0.49	+0.89	−0.9	+0.3
31	Cape	χ^2 Orionis	IB	−0.60	−0.46	−0.59	−0.59	+0.83	−0.03	+0.04	+0.80	+0.52	−1.1	−0.2
Sept. 1	Cape	ζ Geminor.	E	+1.10	−0.93	+0.01	0.00	−0.01	+0.17	+0.01	−0.01	−0.82	+2.4	+1.1
12	Camb., Eng.	29 Ophiuchi	I	−0.43	+0.23	−0.47	−0.76	−0.89	+0.13	−0.08	+0.84	−0.48	+0.4	+1.0
30	Cape	δ Cancri	E	+1.06	+0.97	−0.27	−0.03	+0.27	+0.12	+0.17	+0.22	−0.85	+1.3	0.0
Oct. 13	Camb., Mass.	7 Capricor.	I	−0.74	+0.67	−0.55	−0.10	−0.56	−0.04	−0.06	+0.43	−0.67	0.0	+1.1
14	Camb., Mass.	23 Capricor.	I	−0.65	+0.52	−0.69	+0.01	−0.69	−0.11	−0.05	+0.47	−0.49	−0.3	+0.6
21	Camb., Mass.	87 Ceti	IB	−0.64	−0.02	−0.02	+0.77	−0.77	−0.26	0.00	−0.53	+0.09	−2.7	−1.8
21	Camb., Mass.	87 Ceti	E	+0.79	+0.04	−0.01	+0.63	−0.63	−0.13	0.00	−0.48	−0.22	−0.1	−1.1
Nov. 17	Cape	ξ^1 Ceti	I	−0.16	+0.03	−0.14	+0.98	−0.99	−0.34	−0.02	−0.52	−0.06	+0.2	+0.4
17	Cape	ξ^1 Ceti	EB	+0.54	−0.08	−0.11	+0.84	−0.85	−0.23	−0.24	−0.44	+0.19	−0.1	−0.8
21	Camb., Eng.	64 Orionis	E	+1.02	+0.66	+0.26	+0.21	−0.34	+0.12	+0.08	−0.27	−0.48	+1.3	0.0
21	Camb., Eng.	68 Orionis	IB	−1.08	−0.69	−0.13	−0.10	+0.16	−0.14	+0.07	+0.08	+0.50	−1.7	−0.1
Dec. 17	Greenwich	75 Tauri	I	−1.07	−0.38	−0.04	−0.08	+0.09	−0.12	+0.22	−0.10	−0.28	−1.3	+0.3
1851, Jan. 15	Greenwich	64 Orionis	I	−1.00	−0.59	+0.35	+0.26	−0.44	−0.20	+0.08	−0.51	−0.33	−1.9	−0.4
15	Greenwich	68 Orionis	I	−1.07	−0.63	−0.23	−0.18	+0.29	−0.16	+0.07	+0.22	−0.36	−2.2	−0.6
15	Camb., Eng.	64 Orionis	I	−0.99	−0.59	+0.37	+0.28	+0.46	−0.19	+0.08	−0.53	−0.30	−1.2	+0.3
15	Cracow	64 Orionis	I	−1.10	−0.63	+0.07	+0.06	−0.09	−0.18	+0.08	−0.16	−0.37	−3.0	−1.4
Mar. 9	Cape	68 Tauri	I	−0.99	−0.24	−0.02	−0.03	+0.03	−0.05	+0.21	+0.01	−1.00	−1.7	−0.2
13	Cracow	d^1 Cancri	I	−0.88	−0.77	−0.60	−0.02	+0.61	−0.20	−0.08	+0.46	−0.56	−2.6	−1.3
13	Camb., Eng.	θ Cancri	I	−1.11	−0.92	+0.12	0.00	−0.12	−0.16	−0.15	−0.17	−0.71	−0.8	+0.9
13	Greenwich	d^1 Cancri	I	−0.16	−0.14	−0.97	−0.21	+0.99	+0.32	+0.13	+0.62	−0.10	+4.9	+5.1
13	Greenwich	θ Cancri	I	−1.09	−0.91	−0.20	0.00	+0.20	−0.15	+0.15	−0.14	−0.69	+3.6	+5.2
26	Cape	υ Capricor.	IB	−0.56	+0.55	−0.78	+0.03	−0.78	−0.10	+0.08	+0.59	+0.55	−1.3	−0.5
Apr. 6	Greenwich	m Tauri	I	−0.99	−0.36	−0.14	−0.07	+0.16	−0.05	+0.16	+0.08	−0.91	−4.1	−2.6
6	Camb., Eng.	m Tauri	I	−0.99	−0.36	−0.08	−0.09	+0.12	−0.04	+0.16	+0.05	−0.92	−2.9	−1.4
6	Camb., Eng.	m Tauri	EB	+1.01	+0.36	+0.01	+0.01	−0.02	+0.07	−0.16	+0.05	+0.92	+1.1	−0.2
7	Camb., Eng.	χ^2 Orionis	I	−1.02	−0.56	+0.01	+0.01	−0.01	−0.08	+0.08	−0.08	+0.99	−2.6	−1.1
18	Cape	24 Scorpii	E	+0.40	−0.03	−0.57	−0.72	−0.92	+0.21	+0.04	+0.89	−0.23	+1.6	+1.1
May 17	Cape	μ Sagittarii	IB	−0.71	+0.24	+0.61	+0.33	+0.69	−0.09	−0.04	−0.64	+0.37	−1.7	−0.6
17	Cape	μ Sagittarii	E	+0.58	−0.20	+0.71	+0.37	+0.80	−0.02	+0.05	−0.84	−0.31	−0.1	−0.9
18	Cape	36 Sagittarii	IB	−0.60	+0.30	−0.74	−0.26	−0.79	−0.02	−0.01	+0.74	+0.40	0.0	+0.9
18	Cape	ξ Sagittarii	IB	−0.39	+0.20	+0.86	+0.30	+0.91	−0.01	0.00	−0.86	+0.26	+0.1	+0.7
18	Cape	ξ Sagittarii	E	+0.65	−0.32	+0.70	+0.24	+0.74	+0.03	0.00	−0.78	−0.43	+0.3	−0.5

35990°—12——10

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1851, June 7	Cape	c Virginis	I	−0.82	−0.70	+0.29	−0.58	−0.64	+0.12	−0.32	−0.06	−0.74	−0.4	+0.8
17	Cape	ι Capricor.	E	+0.79	−0.46	−0.47	+0.15	−0.50	−0.11	−0.20	+0.38	−0.38	−0.2	−1.2
July 12	Cape	π Sagittarii	I	−0.93	+0.43	+0.20	+0.05	+0.21	−0.02	+0.02	−0.17	−0.20	−3.2	−1.8
21	Camb., Eng.	ξ^2 Ceti	E	+0.45	−0.26	+0.17	+0.86	−0.88	−0.29	−0.22	−0.46	−0.48	+1.8	+1.2
Aug. 2	Cracow	80 Virginis	I	−1.04	−0.78	−0.02	+0.26	+0.26	−0.23	−0.33	−0.16	−0.88	−1.2	+0.4
8	Cape	ξ Sagittarii	I	−0.81	+0.33	−0.37	−0.09	−0.39	−0.02	−0.01	+0.36	−0.60	−1.3	0.0
8	Cape	ξ Sagittarii	EB	+0.86	−0.33	−0.41	−0.10	−0.42	+0.03	0.00	+0.43	+0.59	+1.9	+0.7
Sept. 4	Cracow	28 Sagittarii	I	−0.94	+0.25	+0.12	+0.03	+0.13	−0.03	−0.01	−0.21	−0.94	−1.0	+0.5
14	Greenwich	μ Ceti	E	+0.85	−0.78	+0.25	+0.32	−0.40	−0.13	−0.33	−0.17	−0.73	+2.6	+1.4
14	Camb., Eng.	μ Ceti	E	+0.84	−0.77	+0.14	+0.39	−0.41	−0.14	−0.32	−0.19	−0.73	+2.1	+0.9
Oct. 2	Camb., Eng.	222 B. Sagittarii	EB	+0.92	−0.30	−0.18	−0.02	−0.18	+0.01	−0.04	+0.25	+0.96	−3.9	−5.2
11	Camb., Eng.	ξ^2 Ceti	IB	−0.73	+0.55	−0.16	−0.60	+0.62	+0.21	+0.32	+0.27	+0.25	−4.7	−3.5
11	Camb., Eng.	ξ^2 Ceti	E	+0.67	−0.50	−0.18	−0.67	+0.69	+0.23	−0.21	+0.47	−0.23	+1.6	+0.7
28	Cape	30 G. Sagittarii	I	−0.71	−0.01	+0.67	+0.25	+0.71	−0.12	−0.06	−0.77	−0.68	−1.6	−0.5
Dec. 5	Cracow	μ Ceti	I	−0.79	+0.62	−0.19	−0.50	+0.54	+0.17	+0.32	+0.26	−0.44	−3.4	−2.2
7	Cape	ε Tauri	I	−0.66	+0.19	+0.54	+0.50	−0.74	−0.21	+0.13	−0.63	−0.07	−1.9	−0.8
7	Cape	ε Tauri	EB	+0.88	−0.26	+0.33	+0.30	−0.45	−0.03	−0.22	−0.42	+0.09	+0.7	−0.5
10	Camb., Eng.	63 Geminor.	IB	−0.99	−0.38	+0.31	+0.01	−0.31	−0.10	−0.04	+0.13	+0.49	−5.9	−4.3
10	Camb., Eng.	63 Geminor.	E	+1.01	+0.39	−0.26	−0.01	+0.26	+0.10	+0.04	+0.34	−0.50	0.0	−1.4
31	Cape	ν Piscium	I	−0.84	+0.83	−0.04	−0.39	+0.39	+0.14	+0.38	+0.09	−0.87	0.0	+1.3
1852, Jan. 4	Cracow	i Tauri	I	−0.74	+0.17	+0.54	+0.40	−0.66	−0.16	+0.14	−0.69	−0.35	−2.0	+0.8
6	Cracow	d Geminor.	I	−0.89	−0.18	+0.48	+0.08	−0.49	−0.10	+0.01	−0.55	−0.04	−1.2	+0.2
Feb. 3	Camb., Eng.	63 Geminor.	I	−1.06	−0.29	−0.03	0.00	+0.03	−0.13	−0.03	−0.07	−0.35	0.0	+1.7
3	Greenwich	63 Geminor.	I	−1.06	−0.29	−0.06	0.00	+0.06	−0.14	−0.04	−0.04	−0.35	−1.6	+0.1
11	Greenwich	30 Libræ	E	+0.72	+0.53	+0.42	+0.58	+0.72	−0.14	+0.26	−0.49	−0.68	+2.4	+1.4
15	Cape	o Sagittarii	IB	−0.87	−0.02	−0.44	−0.02	−0.44	−0.04	0.00	+0.40	+0.68	−0.8	+0.6
15	Cape	o Sagittarii	E	+0.70	+0.01	−0.69	−0.03	−0.69	+0.03	−0.01	+0.72	−0.54	+1.6	+0.6
Mar. 9	Cape	ξ Libræ	IB	−0.96	−0.76	−0.24	−0.44	−0.50	−0.01	−0.32	+0.27	+0.66	−0.7	+0.8
9	Cape	ξ Libræ	E	+0.70	+0.55	−0.38	−0.68	−0.77	+0.37	+0.16	+0.59	−0.48	+1.9	+0.9
30	Cracow	98 B. Cancri	I	−0.65	−0.30	−0.73	+0.30	+0.79	−0.18	−0.08	+0.59	−0.52	−0.6	+0.5
30	Cracow	102 B. Cancri	I	−1.02	−0.48	−0.22	+0.09	+0.24	−0.15	−0.13	+0.12	−0.81	−2.5	−0.9
30	Cracow	107 B. Cancri	I	−0.96	−0.46	−0.37	+0.15	+0.40	−0.16	−0.13	+0.26	−0.77	+0.6	+2.1
Apr. 25	Cracow	∂ Geminor.	I	−0.36	−0.07	−0.93	+0.08	+0.93	−0.05	−0.02	+0.86	−0.36	−3.1	−2.5
27	Cracow	83 Cancri	I	−0.58	−0.33	−0.69	+0.45	+0.84	−0.23	−0.09	+0.56	−0.52	−1.5	−0.5
28	Cracow	37 Leonis	I	−0.52	−0.36	−0.59	+0.64	+0.87	−0.31	−0.10	+0.42	−0.44	−2.4	−1.6
May 2	Camb., Eng.	94 Virginis	I	−0.97	−0.81	+0.19	+0.49	+0.53	−0.39	−0.28	−0.33	−0.13	−0.2	+1.4
July 4	Camb., Eng.	29 Aquarii	E	+0.87	−0.47	−0.35	+0.24	−0.42	−0.07	−0.28	+0.32	−0.56	−3.5	−4.8
Aug. 25	Cracow	49 Sagittarii	I	−0.97	−0.28	+0.24	−0.05	+0.24	−0.08	+0.03	−0.33	−0.77	−2.5	−0.9
26	Camb., Eng.	36 B. Capricor.	I	−0.70	+0.07	+0.62	−0.33	+0.71	+0.04	+0.12	−0.66	−0.35	−3.7	−2.5
Sept. 18	Cracow	ν Scorpii	I	−1.08	−0.85	+0.10	+0.04	+0.10	−0.20	−0.27	−0.18	−0.87	−2.6	−0.8
23	Cape	η Capricor.	I	−0.62	+0.03	+0.61	−0.46	+0.77	+0.11	+0.16	−0.56	−0.55	−1.6	−0.5
Oct. 24	Cracow	30 Piscium	I	−0.64	+0.48	−0.08	+0.71	−0.71	−0.27	+0.22	−0.34	−0.48	−0.9	+0.2
24	Greenwich	30 Piscium	I	−0.46	+0.37	−0.04	+0.86	−0.86	−0.33	+0.13	+0.35	−0.34	+5.8	+6.6
24	Greenwich	33 Piscium	I	−0.83	+0.66	−0.02	+0.42	−0.42	−0.17	+0.33	+0.19	−0.61	−3.9	−2.5
1853, Jan. 14	Camb., Eng.	30 Piscium	E	+0.59	−0.39	+0.02	−0.78	−0.78	−0.29	−0.32	+0.12	+0.53	−1.4	−2.3
14	Camb., Eng.	33 Piscium	I	−0.91	+0.60	+0.01	+0.26	−0.26	−0.13	+0.36	−0.08	−0.81	−1.1	+0.5
14	Camb., Eng.	33 Piscium	EB	+0.94	−0.62	0.00	−0.01	+0.01	+0.03	−0.40	+0.11	+0.84	−1.9	−3.4
Feb. 17	Camb., Eng.	n Tauri	I	−0.65	+0.67	+0.57	+0.07	−0.58	+0.01	+0.13	+0.75	−0.70	+5.4	+6.6
18	Cracow	1 Geminor.	I	−0.88	+0.66	+0.25	−0.01	−0.25	−0.03	+0.08	−0.33	−0.80	−0.9	+0.7
Mar. 26	Camb., Eng.	95 Virginis	IB	−1.13	−0.93	+0.04	+0.05	+0.06	−0.25	−0.39	−0.11	+0.44	−1.8	+0.3
26	Camb., Eng.	95 Virginis	E	+1.10	+0.91	−0.12	−0.16	−0.20	+0.29	+0.38	+0.18	−0.43	+4.0	+2.2
26	Greenwich	κ Virginis	E	+1.12	+0.93	+0.06	+0.08	+0.10	+0.18	+0.41	+0.03	−0.44	+2.3	+0.5
28	Greenwich	β Scorpii	IB	−1.06	−0.95	+0.29	+0.12	+0.32	−0.29	−0.26	−0.36	+0.74	−2.1	−0.1
Apr. 20	Camb., Eng.	ν Virginis	EB	+1.08	+0.56	0.00	−0.05	−0.05	+0.19	+0.39	+0.08	+0.52	+0.9	−0.9
20	Cape	ξ Virginis	I	−0.40	−0.21	+0.02	−0.93	−0.93	+0.29	−0.23	−0.18	−0.20	−0.4	+0.4
May 12	Cracow	42 Geminor.	I	−0.80	+0.54	+0.44	−0.18	−0.48	0.00	−0.01	−0.67	−0.74	−0.6	+0.9
20	Cracow	95 Virginis	I	−0.94	−0.81	−0.36	−0.44	−0.57	+0.03	−0.38	+0.23	−0.36	−4.0	−2.2
20	Camb., Eng.	95 Virginis	I	−1.11	+0.89	−0.12	−0.14	−0.18	−0.15	−0.41	0.00	−0.43	−4.2	−2.1
20	Camb., Eng.	95 Virginis	EB	+1.01	+0.81	−0.30	−0.34	−0.45	+0.38	+0.32	+0.30	+0.37	+1.5	−0.2
20	Greenwich	95 Virginis	I	−1.12	−0.90	−0.10	−0.11	−0.15	−0.16	+0.41	−0.01	−0.43	−6.3	−4.2
22	Greenwich	β Scorpii	E	+1.03	+0.88	−0.45	−0.16	−0.48	+0.37	+0.23	+0.49	+0.02	−1.5	−3.3
July 17	Cracow	157 B. Ophiuchi	I	−1.10	−0.96	+0.19	0.00	+0.19	−0.25	−0.17	−0.27	−0.60	−2.5	−0.3
Aug. 29	Greenwich	48 Geminor.	E	+0.92	−0.79	−0.02	+0.01	+0.02	+0.01	+0.03	+0.11	−0.76	+2.4	+0.8
Sept. 6	Cape	88 Virginis	I	−1.02	−0.70	−0.21	−0.24	−0.32	−0.04	−0.42	+0.05	−0.63	−3.6	−1.6
8	Cape	174 B. Libræ	I	−0.97	−0.86	+0.42	+0.15	+0.45	−0.30	−0.25	−0.45	−0.82	−1.1	+0.8
11	Cape	126 B. Sagittarii	I	−0.83	−0.70	+0.57	−0.25	+0.62	−0.14	−0.01	−0.68	−0.75	−0.8	+0.9
20	Greenwich	38 Arietis	E	+0.84	−0.76	−0.34	−0.22	+0.41	+0.16	−0.31	+0.34	−0.56	+0.2	−1.3
20	Camb., Eng.	38 Arietis	IB	−0.92	+0.83	−0.08	−0.05	+0.09	+0.02	+0.39	−0.04	+0.60	−2.2	−0.4
Oct. 14	Greenwich	33 Piscium	I	−0.92	+0.12	−0.10	−0.34	+0.35	+0.07	+0.43	+0.11	−0.51	−3.3	−1.5
Dec. 8	Cape	54 B. Ceti	I	−0.40	+0.04	−0.35	−0.84	+0.91	+0.36	+0.18	+0.01	−0.42	−1.8	−1.0

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$t\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													"	"
1853, Dec. 9	Camb., Eng.	33 Ceti	I	−0.08	+0.03	+0.60	+0.80	−1.00	−0.43	−0.06	−0.26	−0.03	+0.5	+0.7
1854, Jan. 7	Cracow	ξ Arietis	I	−0.86	+0.64	−0.30	−0.20	+0.36	+0.13	−0.39	+0.12	−0.90	−3.9	−2.0
Feb. 7	Camb., Eng.	121 Tauri	I	−0.87	+0.97	−0.23	+0.06	+0.24	+0.04	−0.13	+0.17	−0.85	−2.0	−0.2
9	Camb., Eng.	52 Geminor.	I	−0.80	+0.84	−0.37	+0.29	+0.47	−0.02	−0.04	+0.82	−0.51	0.0	+1.7
9	Camb., Eng.	52 Geminor.	EB	+0.83	−0.86	−0.33	+0.26	+0.42	−0.01	+0.04	+0.47	+0.49	−1.6	−3.2
Mar. 3	Cracow	31 Arietis	I	−0.85	+0.54	−0.39	−0.20	+0.44	+0.13	+0.39	+0.18	−0.71	−2.7	−0.8
7	Cape	139 Tauri	I	−0.26	+0.29	−0.89	+0.36	+0.96	+0.08	+0.04	+0.93	−0.28	−0.5	+0.1
7	Cape	139 Tauri	EB	+0.39	−0.44	−0.83	+0.35	+0.90	+0.08	−0.04	+0.93	+0.43	−3.1	−3.9
12	Camb., Eng.	42 Leonis	I	−0.77	+0.37	−0.04	+0.60	+0.60	−0.25	−0.24	+0.24	−0.25	−1.0	+0.7
12	Camb., Eng.	167 B. Leonis	I	−0.96	+0.45	+0.01	−0.22	−0.22	−0.01	−0.36	−0.18	−0.30	−0.9	+1.2
20	Cape	b Ophiuchi	E	+1.07	+0.98	−0.08	+0.02	−0.09	+0.19	+0.15	+0.09	−0.99	+3.0	+0.9
22	Cape	h Sagittarii	IB	−1.06	−0.95	−0.10	+0.10	−0.14	−0.18	+0.08	+0.09	+0.94	−1.6	+0.6
22	Cape	h Sagittarii	E	+0.97	+0.87	−0.31	+0.30	−0.43	+0.13	−0.08	+0.44	−0.86	+1.9	0.0
Apr. 4	Camb., Eng.	ε Geminor.	I	−0.16	+0.18	−0.81	+0.55	+0.98	+0.01	0.00	+0.98	−0.25	−1.8	−1.5
13	Cape	κ Virginis	IB	−0.81	−0.41	+0.56	+0.34	+0.66	−0.41	−0.24	−0.36	+0.18	−2.8	−1.0
13	Cape	κ Virginis	E	+1.04	+0.52	+0.23	+0.14	+0.27	+0.08	+0.42	−0.11	−0.23	+1.4	−0.7
15	Cape	ω¹ Scorpii	E	+0.79	+0.63	+0.69	+0.02	+0.69	−0.03	+0.24	−0.65	−0.46	+3.0	+1.4
May 6	Greenwich	i Leonis	I	−0.70	+0.43	+0.03	+0.67	+0.67	−0.28	−0.23	+0.27	−0.68	−2.7	−1.1
9	Camb., Eng.	48 Virginis	I	−0.96	−0.20	+0.27	+0.28	+0.39	−0.31	−0.37	−0.15	−0.42	−1.0	+1.2
9	Camb., Eng.	48 Virginis	EB	+1.02	+0.22	+0.14	+0.15	+0.20	+0.05	+0.45	+0.01	+0.47	−0.1	−2.2
11	Cape	6 B. Libræ	I	−0.96	−0.55	−0.43	−0.19	−0.47	+0.01	−0.39	+0.21	−0.07	−3.2	−1.0
11	Cape	μ Libræ	I	−0.92	−0.51	−0.52	−0.18	−0.55	+0.02	−0.36	+0.30	−0.07	−2.8	−0.7
11	Cape	μ Libræ	EB	+0.86	+0.48	−0.60	−0.20	−0.63	+0.40	+0.24	+0.47	+0.06	−8.5	−10.3
22	Cape	μ Piscium	IB	−0.91	+0.09	+0.24	+0.21	−0.32	−0.21	+0.38	−0.15	+0.68	−1.7	+0.4
June 7	Cape	κ Virginis	I	−1.04	−0.47	−0.20	−0.11	−0.22	−0.08	−0.44	+0.07	−0.60	−1.7	+0.7
7	Cape	κ Virginis	EB	+0.94	+0.42	+0.42	+0.22	+0.48	+0.03	+0.41	−0.22	+0.55	+3.5	+1.5
14	Cape	κ Capricor.	IB	−0.98	−0.74	−0.09	+0.44	−0.45	+0.31	+0.24	+0.22	+0.69	−1.5	+0.8
14	Cape	κ Capricor.	E	+0.89	+0.67	−0.11	+0.57	−0.58	0.00	−0.28	+0.45	−0.69	+1.8	−0.1
28	Cape	ξ Cancri	I	−0.78	+0.74	+0.15	−0.48	−0.50	+0.11	−0.24	−0.44	−0.54	+1.9	+3.7
28	Cape	79 Cancri	I	−0.55	+0.53	+0.24	−0.76	−0.79	+0.18	−0.18	−0.64	−0.38	+1.2	+2.5
July 5	Cape	μ Libræ	I	−0.48	−0.27	−0.86	−0.25	−0.89	+0.25	−0.25	+0.56	−0.36	−1.0	+0.1
7	Cracow	18 Ophiuchi	I	−0.96	−0.74	+0.47	−0.12	+0.49	−0.31	−0.18	−0.56	−0.45	−4.3	−2.0
13	Cape	ψ³ Aquarii	E	+0.79	+0.43	−0.19	−0.65	+0.68	+0.41	−0.22	−0.12	−0.53	+1.7	0.0
31	Cracow	m Virginis	I	−0.74	−0.18	+0.57	+0.36	+0.67	−0.35	−0.25	−0.32	−0.73	−0.8	+0.9
Sept. 2	Cape	201 B. Sagittarii	I	−0.96	−0.87	−0.33	+0.38	−0.50	−0.22	+0.04	+0.43	−0.70	−3.3	−1.1
2	Cape	201 B. Sagittarii	EB	+1.08	+0.97	−0.15	+0.17	−0.22	+0.21	−0.05	+0.25	+0.79	−6.6	−8.9
4	Camb., Eng.	35 Capricor.	I	−1.11	−0.90	+0.02	−0.13	+0.13	−0.19	+0.30	−0.17	−0.49	−2.6	0.0
4	Camb., Eng.	35 Capricor.	EB	+1.04	+0.85	+0.06	−0.37	+0.37	+0.32	−0.26	−0.19	+0.46	−3.6	−5.8
19	Greenwich	i Leonis	E	+0.93	−0.73	+0.01	+0.06	+0.06	+0.02	+0.38	+0.08	−0.39	+2.8	+0.8
30	Greenwich	ω Sagittarii	I	−1.06	−0.98	−0.09	+0.16	−0.18	−0.20	+0.13	+0.09	−0.94	−3.9	−1.4
30	Greenwich	ω Sagittarii	EB	+1.08	−1.00	−0.05	+0.09	−0.10	+0.18	−0.14	+0.17	+0.96	−1.0	−3.3
30	Greenwich	A Sagittarii	I	−1.08	−1.00	−0.02	+0.04	−0.04	−0.19	+0.14	−0.04	−0.96	−4.2	−1.7
30	Camb., Eng.	ω Sagittarii	I	−1.05	−0.98	−0.09	+0.16	−0.18	−0.20	+0.13	+0.09	−0.95	−3.1	−0.6
30	Camb., Eng.	A Sagittarii	I	−1.08	−1.00	−0.02	+0.04	−0.05	−0.20	+0.14	−0.03	−0.96	−2.7	−0.1
30	Cracow	ω Sagittarii	I	−1.08	−1.00	0.00	+0.01	−0.01	−0.20	+0.11	−0.08	−0.96	−4.6	−2.0
30	Cracow	A Sagittarii	I	−1.04	−0.95	+0.16	−0.28	+0.32	−0.16	+0.13	−0.37	−0.91	−2.4	+0.1
Oct 11	Greenwich	139 Tauri	E	+0.85	−0.81	−0.30	+0.19	+0.36	+0.05	−0.08	+0.42	−0.84	+1.8	−0.1
29	Cape	κ Capricor.	I	−1.05	−0.92	−0.01	+0.15	−0.15	−0.22	+0.30	+0.02	−0.98	−4.9	−2.4
Nov. 27	Cape	ψ² Aquarii	I	−1.04	−0.78	−0.03	−0.07	+0.07	−0.13	+0.42	−0.08	−1.00	−2.6	0.0
27	Cape	ψ² Aquarii	EB	+0.95	+0.71	−0.10	−0.40	+0.41	+0.31	−0.34	−0.05	+0.91	−0.3	−2.5
Dec. 10	Greenwich	i Leonis	E	+0.87	−0.79	−0.05	−0.23	−0.24	+0.09	+0.35	−0.04	−0.94	+1.7	−0.3
1855, Jan. 3	Cape	υ Geminor.	E	+0.86	−0.92	+0.16	−0.27	−0.31	+0.05	+0.09	−0.29	−0.09	+3.7	+1.7
Mar 23	Camb., Eng.	k Tauri	I	−0.77	+0.42	+0.52	−0.28	−0.59	−0.15	+0.14	−0.55	−0.72	−1.9	+0.1
Apr. 4	Cape	8 Libræ	E	+0.90	+0.08	−0.43	−0.01	−0.43	+0.17	+0.31	+0.32	−0.51	+1.9	−0.3
4	Cape	α Libræ	IB	−0.99	−0.09	+0.06	0.00	+0.06	−0.14	−0.37	−0.03	+0.57	−3.9	−1.2
4	Cape	α Libræ	E	+0.91	+0.08	−0.39	−0.01	−0.39	+0.25	+0.32	+0.29	−0.52	+2.4	+0.1
7	Greenwich	X Sagittarii	E	+1.00	+0.71	−0.16	+0.15	−0.22	+0.16	+0.10	+0.28	−0.93	+3.6	+1.1
8	Cape	φ Sagittarii	IB	−0.96	−0.78	−0.24	+0.32	−0.41	−0.16	0.00	+0.37	+0.90	−2.5	+0.1
8	Cape	φ Sagittarii	E	+0.79	+0.65	−0.39	+0.53	−0.66	+0.12	−0.02	+0.70	−0.75	+1.2	−0.8
23	Greenwich	λ Cancri	I	−0.81	+0.86	−0.10	+0.43	+0.44	−0.09	−0.17	+0.33	−0.90	−3.5	−1.3
23	Camb., Eng.	λ Cancri	EB	+0.90	−0.95	−0.04	+0.16	+0.16	−0.01	+0.21	+0.19	+0.98	−2.4	−4.6
May 8	Cape	ε Capricor.	IB	−0.79	−0.74	+0.05	+0.67	−0.67	−0.34	+0.20	+0.37	+0.74	−3.4	−1.2
June 27	Camb., Eng.	22 Scorpii	EB	+1.04	+0.34	+0.20	−0.10	+0.22	+0.13	+0.25	−0.15	+0.39	−7.1	−9.7
Aug. 30	Camb., Eng.	o Piscium	IB	−1.09	−0.82	+0.07	+0.01	−0.07	−0.24	+0.44	−0.09	+0.63	−1.6	+1.5
30	Greenwich	o Piscium	IB	−1.08	−0.82	+0.06	+0.01	−0.06	−0.22	+0.43	−0.08	+0.64	−2.0	+1.1
30	Greenwich	o Piscium	E	+1.05	+0.80	−0.25	−0.05	+0.25	+0.30	−0.40	+0.17	−0.62	+2.9	+0.1
Sept. 20	Camb., Eng.	234 B. Sagittarii	I	−0.88	−0.66	−0.18	+0.51	−0.54	−0.19	+0.08	+0.45	−0.79	−3.4	−0.8
21	Camb., Eng.	40 B. Capricor.	I	−0.96	−0.79	+0.02	+0.48	−0.48	−0.29	+0.19	+0.35	−0.81	−4.3	−1.5
Oct. 24	Camb., Eng.	o Piscium	I	−0.91	−0.57	−0.57	−0.08	+0.58	+0.07	+0.43	+0.20	−0.17	−1.6	+1.1
24	Greenwich	o Piscium	I	−0.89	−0.56	−0.58	−0.08	+0.59	+0.08	+0.42	+0.21	−0.16	−5.2	−2.5

GROUP X—1839–1856—Continued.

Date.		Place.	Star.		Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
															"	"
1855, Nov.	15	Camb., Eng.	86	B. Capricor.	I	−1.01	−0.88	+0.03	+0.27	−0.27	−0.23	+0.25	+0.16	−0.95	−2.2	+0.8
1856, Jan.	12	Greenwich	29	Piscium	I	−0.41	−0.38	+0.80	+0.48	−0.93	−0.51	+0.07	+0.03	−0.34	−0.6	+0.7
Mar.	11	Camb., Eng.	33	Tauri	I	−0.93	−0.43	+0.38	+0.24	−0.45	−0.26	+0.23	−0.42	−0.77	−1.9	+1.1
	13	Camb., Eng.	136	Tauri	I	−0.98	−0.05	−0.02	+0.03	+0.03	−0.09	+0.07	0.00	−1.00	−3.9	−0.8
	13	Greenwich	136	Tauri	I	−0.98	−0.05	+0.04	−0.06	−0.07	−0.10	−0.07	−0.04	−1.00	−4.9	−1.8
	26	Greenwich		α Scorpii	IB	−0.91	+0.18	+0.20	−0.18	+0.27	−0.12	−0.23	−0.28	+0.89	−1.2	+1.7
	26	Camb., Eng.		α Scorpii	I	−0.90	+0.18	+0.20	−0.17	+0.26	−0.11	−0.22	−0.27	+0.88	−1.7	+1.2
Apr.	25	Cape		τ Sagittarii	IB	−1.00	+0.37	−0.01	+0.06	−0.06	−0.14	+0.08	+0.03	+0.96	−6.9	−3.6
	25	Cape		τ Sagittarii	E	+1.00	−0.37	+0.01	−0.03	+0.03	+0.13	−0.01	−0.02	−0.96	+5.5	+2.4
June	16	Camb., Eng.		α Scorpii	I	−0.96	+0.34	+0.10	−0.09	+0.13	−0.12	−0.22	−0.14	−0.23	−1.9	+1.4
July	25	Camb., Eng.	63	Arietis	IB	−0.12	−0.08	+0.84	−0.52	−0.99	−0.34	−0.02	−0.79	−0.29	+3.8	+4.2
Sept.	8	Cape	38	B. Sagittarii	I	−0.86	+0.08	+0.14	−0.46	+0.48	−0.11	−0.02	−0.51	−0.84	−3.7	−0.6
	20	Greenwich	136	Tauri	IB	−0.44	−0.19	−0.31	+0.85	+0.90	0.00	+0.03	+0.89	+0.43	+2.8	+4.4
	20	Camb., Eng.	136	Tauri	IB	−0.49	−0.22	−0.30	+0.82	+0.87	−0.01	+0.03	+0.86	+0.50	−1.0	+0.8
	20	Camb., Eng.	136	Tauri	E	+0.26	+0.11	−0.33	+0.91	+0.97	+0.08	−0.01	+0.97	−0.22	+1.1	+0.2
Nov.	11	Camb., Eng.	40	Arietis	I	−0.87	−0.70	+0.57	−0.32	−0.65	−0.43	+0.24	−0.46	−0.11	−0.8	+2.5
	12	Cape		η Tauri	IB	−1.12	−0.82	−0.08	+0.08	+0.11	−0.22	−0.30	+0.12	+0.05	−5.1	−1.0

GROUP XI—1857–1873.

Date.		Place.	Star.		Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
1857, Jan.	15	Cape		η Virginis	IB	−0.72	+0.72	−0.60	−0.08	−0.61	+0.26	−0.46	+0.01	+0.73	−4.4	−1.7
	15	Cape		η Virginis	E	+0.42	−0.80	−0.88	−0.11	−0.89	+0.44	+0.10	+0.06	−0.81	+3.4	+1.9
Feb.	6	Cape		φ Geminor.	IB	−0.87	−0.15	−0.13	−0.49	−0.51	−0.03	−0.19	−0.47	−0.41	−3.6	−0.2
Mar.	4	Camb., Eng.	49	Aurigæ	E	+1.01	+0.51	0.00	−0.11	−0.11	+0.14	+0.05	−0.11	+0.95	0.0	−3.7
	16	Cape		σ Scorpii	IB	−0.85	+0.74	−0.18	+0.29	−0.35	+0.05	−0.23	+0.31	+0.91	−4.0	−0.7
	16	Cape		σ Scorpii	E	+0.63	−0.55	−0.37	+0.61	−0.71	+0.17	+0.13	+0.68	−0.68	+1.5	−0.9
	16	Cape		α Scorpii	IB	−0.91	+0.79	−0.04	+0.07	−0.08	−0.03	−0.21	+0.10	+1.00	−4.1	−0.5
	18	Cape	38	B. Sagittarii	I	+0.01	0.00	−0.13	+0.99	−1.00	+0.01	0.00	+1.00	0.00	+8.5	+8.5
	18	Cape	38	B. Sagittarii	E	+0.34	−0.17	+0.12	−0.92	+0.93	+0.01	+0.01	−0.93	−0.35	+2.5	+1.2
	19	Cape		τ Sagittarii	E	+0.63	−0.17	−0.07	−0.76	+0.76	+0.14	−0.07	−0.78	−0.60	+3.0	+0.6
	31	Cape		κ Aurigæ	I	−0.88	−0.54	+0.04	−0.54	−0.54	−0.15	0.00	−0.50	−0.81	−2.6	+0.9
Apr.	2	Camb., Eng.		λ Cancri	I	−0.92	−0.21	−0.16	−0.34	−0.37	−0.02	−0.25	−0.32	−0.92	−2.5	+1.2
	2	Camb., Eng.		λ Cancri	EB	+0.77	+0.18	−0.26	−0.56	−0.62	+0.23	+0.18	−0.53	+0.74	−0.9	−3.8
	2	Greenwich		λ Cancri	I	−0.93	−0.22	−0.14	−0.31	−0.34	−0.03	−0.25	−0.30	−0.92	−3.5	+0.3
	29	Cape		φ Geminor.	I	−1.01	−0.37	−0.05	−0.15	−0.16	−0.13	−0.21	−0.17	−0.92	−4.2	−0.1
May	6	Greenwich		α Virginis	I	−0.92	+0.84	+0.44	−0.13	+0.46	−0.32	−0.45	−0.23	−0.38	−2.9	+0.9
	6	Greenwich		α Virginis	EB	+0.82	−0.87	+0.36	−0.11	+0.37	−0.16	+0.46	−0.14	+0.40	+1.6	−1.5
	6	Camb., Eng.		α Virginis	EB	+0.85	−0.88	+0.32	−0.08	+0.33	−0.13	+0.46	−0.13	+0.42	+2.6	−0.7
	27	Greenwich		γ Cancri	I	−0.40	−0.07	+0.50	+0.77	+0.92	−0.31	−0.08	+0.54	−0.31	+0.5	+2.1
	31	Cape		β Virginis	I	−0.45	+0.30	+0.87	+0.11	+0.87	−0.44	−0.13	+0.08	−0.47	−3.5	−1.7
July	27	Cape		α Virginis	I	−0.71	+0.68	+0.58	−0.24	+0.63	−0.31	−0.27	−0.27	+0.75	−4.1	−1.1
Sept.	29	Leiden	128	B. Capricor.	I	−0.66	+0.02	+0.59	+0.49	−0.76	−0.36	+0.19	+0.57	−0.46	−3.7	−0.9
	30	Camb., Eng.	50	Aquarii	I	−0.93	−0.18	−0.42	−0.19	+0.46	+0.04	+0.43	−0.22	−0.50	−1.3	+2.6
Oct.	6	Camb., Eng.	27	Tauri	IB	−0.73	−0.65	+0.36	−0.67	−0.76	−0.34	+0.15	−0.65	+0.41	−2.1	+1.0
	6	Camb., Eng.	27	Tauri	E	+0.89	+0.79	+0.29	−0.55	−0.62	+0.04	−0.24	−0.52	−0.38	−1.3	−4.9
	6	Camb., Eng.	28	Tauri	IB	−0.17	−0.15	+0.47	−0.87	−0.99	−0.29	0.00	−0.84	+0.07	−0.2	+0.5
	6	Camb., Eng.	28	Tauri	E	+0.40	+0.35	+0.44	−0.83	−0.94	−0.14	−0.13	−0.80	−0.26	+2.0	+0.4
	6	Greenwich	27	Tauri	IB	−0.74	−0.66	+0.36	−0.66	−0.75	−0.34	+0.15	−0.64	+0.44	−2.2	+1.0
	6	Greenwich	27	Tauri	E	+0.88	+0.79	+0.29	+0.54	−0.61	+0.03	−0.24	−0.51	−0.52	+4.4	+0.8
	26	Greenwich		χ Capricor.	I	−0.97	+0.16	0.00	0.00	0.00	−0.09	+0.34	−0.01	−0.97	−4.9	−0.6
	28	Greenwich	70	Aquarii	I	−0.84	−0.07	−0.56	−0.16	+0.58	+0.13	+0.43	−0.23	−0.80	−3.3	−0.4
Nov.	23	Cape		γ Capricor.	I	−0.94	+0.07	−0.17	−0.12	+0.21	−0.02	+0.39	−0.15	−0.98	−3.0	+1.2
	23	Cape		γ Capricor.	EB	+0.74	−0.54	−0.53	−0.35	+0.64	+0.30	−0.23	−0.42	+0.77	−2.1	−5.2
	27	Camb., Eng.		ε Piscium	I	−0.77	−0.55	−0.67	+0.27	+0.72	+0.17	+0.40	+0.19	−0.52	−5.0	−1.6
	27	Greenwich		ε Piscium	I	−0.73	−0.51	−0.70	+0.78	+0.75	+0.19	+0.38	+0.20	−0.46	−4.4	−1.2
Dec.	26	Leiden	B.D.+18° 325		I	−0.65	−0.56	+0.53	−0.62	−0.81	−0.42	+0.16	−0.52	−0.45	−1.6	+1.3
1858, Feb.	19	Camb., Eng.		ε Arietis	I	−0.82	−0.71	+0.36	−0.53	−0.64	−0.34	+0.22	−0.45	−0.72	+0.2	+3.9
	20	Camb., Eng.		q Tauri	I	−1.06	−0.96	+0.07	−0.18	−0.19	−0.24	+0.26	−0.15	−0.97	−3.9	+0.9
	20	Camb., Eng.		q Tauri	EB	+1.07	+0.98	0.00	+0.01	+0.01	+0.19	−0.27	0.00	+1.00	+6.5	+1.9
	20	Camb., Eng.	20	Tauri	EB	+0.92	+0.84	−0.20	+0.48	+0.52	+0.29	−0.20	+0.42	+0.84	+4.5	+0.5
	20	Greenwich	20	Tauri	I	−0.98	−0.90	−0.15	+0.36	+0.39	−0.08	+0.26	+0.35	−0.92	−3.0	+1.5
Mar.	6	Cape		α Scorpii	IB	−0.88	+0.97	−0.04	+0.20	−0.20	+0.02	−0.18	+0.21	+0.97	−3.7	+0.3
	6	Cape		α Scorpii	E	+0.77	−0.85	−0.10	+0.51	−0.52	+0.10	+0.14	+0.50	−0.85	+5.2	+1.8
Apr.	25	Greenwich	28	Virginis	I	−0.95	+0.29	+0.13	−0.05	+0.14	−0.15	−0.45	+0.01	−0.49	−4.6	−0.2
May	18	Greenwich	83	Cancri	I	−0.34	−0.22	−0.84	−0.46	−0.95	+0.27	−0.19	−0.66	−0.30	−1.9	−0.3
	18	Camb., Eng.	83	Cancri	I	−0.27	−0.18	−0.85	−0.47	−0.97	+0.30	−0.17	−0.68	−0.31	−0.8	+0.5
	19	Camb., Eng.		α Leonis	I	−0.36	−0.18	+0.89	+0.26	+0.93	−0.43	−0.07	+0.51	−0.28	−2.6	−0.9
	19	Camb., Eng.		α Leonis	EB	+0.63	+0.30	+0.77	+0.22	+0.80	−0.23	+0.34	+0.40	+0.67	+2.1	−0.7
	19	Greenwich		α Leonis	EB	+0.53	+0.26	−0.83	−0.24	−0.86	+0.43	+0.13	−0.48	+0.52	−6.4	−8.8
	20	Leiden	56	Leonis	I	−0.62	−0.18	+0.78	+0.05	+0.78	−0.42	−0.20	+0.28	−0.61	−2.9	0.0

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1858, Aug. 30	Greenwich	q Tauri	IB	−1.06	−0.84	−0.01	+0.06	+0.06	−0.17	+0.25	+0.08	+0.98	−10.8	−5.7
30	Greenwich	q Tauri	E	+0.99	+0.79	−0.08	+0.34	+0.35	+0.25	−0.23	+0.28	−0.92	+ 5.2	+0.7
30	Greenwich	20 Tauri	IB	−0.80	−0.64	−0.14	+0.64	+0.65	+0.02	+0.22	+0.55	+0.74	− 8.9	−5.1
30	Greenwich	16 Tauri	E	+0.65	+0.52	−0.17	+0.76	+0.78	+0.28	−0.14	+0.65	−0.61	+ 2.6	−0.4
30	Camb., Eng.	16 Tauri	IB	−0.88	−0.70	−0.12	+0.55	+0.56	−0.02	+0.23	+0.49	+0.82	− 6.9	−2.7
30	Camb., Eng.	q Tauri	IB	−1.06	−0.84	−0.01	+0.04	+0.04	−0.17	+0.25	+0.06	+0.98	− 7.2	−2.1
30	Camb., Eng.	q Tauri	E	+1.00	+0.79	−0.07	+0.32	+0.33	+0.24	−0.22	+0.25	−0.92	+ 4.2	−0.4
30	Camb., Eng.	20 Tauri	IB	−0.83	−0.66	−0.13	+0.61	−0.62	+0.01	+0.22	+0.54	+0.77	− 7.0	−3.0
Sept. 18	Camb., Eng.	17 Capricor.	I	−0.71	+0.62	+0.54	+0.33	−0.63	−0.23	+0.23	+0.53	−0.53	− 5.6	−2.2
21	Leiden	82 Aquarii	I	−0.67	+0.20	+0.73	−0.06	−0.73	−0.41	+0.23	+0.25	−0.17	− 2.7	+0.5
Oct. 12	Cape	X Sagittarii	I	−0.85	+0.92	+0.12	+0.33	−0.35	−0.02	−0.01	+0.38	−0.85	− 4.1	0.0
14	Cape	h Sagittarii	I	−0.90	+0.97	0.00	0.00	+0.01	−0.02	+0.21	−0.02	−1.00	− 4.8	−0.5
21	Leiden	210 B. Piscium	I	−0.94	−0.24	−0.32	+0.29	+0.43	+0.06	+0.44	+0.15	−0.11	− 2.2	+2.3
Nov. 22	Greenwich	136 Tauri	E	+1.14	+0.96	+0.01	+0.02	+0.02	+0.26	+0.01	−0.03	−0.40	+ 8.1	+2.8
22	Camb., Eng.	136 Tauri	IB	−1.11	−0.93	−0.08	−0.20	−0.22	−0.25	+0.01	−0.20	+0.39	− 6.5	−1.2
22	Camb., Eng.	136 Tauri	E	+1.14	+0.96	−0.01	−0.02	−0.02	+0.25	0.00	−0.05	−0.40	+ 7.7	+2.4
Dec. 22	Leiden	40 Cancri	E	+0.50	+0.42	+0.80	+0.41	+0.90	−0.15	+0.19	+0.70	−0.22	+ 3.6	+1.3
22	Leiden	39 Cancri	E	+0.68	+0.58	+0.71	+0.37	+0.80	−0.09	+0.24	+0.61	−0.30	+ 3.9	+0.7
1859, Jan. 21	Cape	c Leonis	E	+1.07	+0.66	−0.23	+0.05	−0.23	+0.33	+0.42	−0.08	−0.55	+ 6.2	+1.2
Feb. 8	Cape	η Piscium	I	−0.70	−0.15	+0.40	−0.57	−0.70	−0.36	+0.23	−0.20	−0.68	− 1.8	+1.6
11	Cape	φ Tauri	I	−0.25	−0.77	+0.11	+0.97	+0.97	+0.10	+0.05	+0.87	−0.91	+ 0.4	+1.6
16	Camb., Eng.	ψ Leonis	I	−1.01	−0.78	−0.45	−0.06	−0.45	−0.04	−0.40	−0.23	−0.13	− 5.1	−0.1
Apr. 11	Leiden	176 B. Cancri	I	−1.07	−0.96	−0.11	−0.03	−0.11	−0.16	−0.36	0.00	−0.93	− 3.8	+1.5
13	Greenwich	37 Sextantis	I	−0.78	−0.55	−0.68	+0.13	−0.69	+0.17	−0.40	−0.20	−0.51	− 9.1	−5.2
May 5	Leiden	112 B. Aurigæ	I	−0.66	−0.51	+0.37	+0.70	+0.79	−0.11	+0.01	+0.80	−0.40	− 3.2	+0.1
5	Leiden	112 B. Aurigæ	EB	+0.86	+0.66	+0.30	+0.55	+0.62	+0.06	0.00	+0.57	+0.52	+ 2.5	−1.6
7	Leiden	82 Geminor.	I	−1.08	−0.98	+0.14	+0.09	+0.16	−0.18	+0.25	+0.21	−0.90	− 4.6	+0.8
Aug. 18	Cape	η Piscium	IB	+0.03	−0.01	+0.44	−0.90	−1.00	−0.39	−0.11	+0.07	−0.04	+ 0.1	+0.3
18	Cape	η Piscium	E	+0.38	−0.08	+0.40	−0.83	−0.91	−0.33	−0.24	−0.43	−0.37	+ 2.4	+0.6
Sept. 21	Greenwich	μ² Cancri	E	+0.97	+0.84	+0.44	+0.16	+0.47	+0.07	+0.26	+0.36	−0.77	+ 6.0	+1.2
Oct. 28	Cape	α Scorpii	I	−0.97	+0.22	−0.07	−0.18	+0.20	−0.13	−0.13	−0.14	−0.42	− 5.4	−0.5
28	Cape	α Scorpii	EB	+0.88	−0.21	−0.18	−0.43	+0.47	+0.04	+0.13	−0.46	+0.38	+ 5.9	+1.6
Nov. 8	Cape	η Piscium	I	−0.55	+0.21	+0.30	−0.77	−0.83	−0.38	+0.14	−0.27	−0.20	− 1.4	+1.4
11	Leiden	χ Tauri	IB	−0.93	−0.29	+0.16	+0.44	+0.46	−0.07	+0.14	+0.45	+0.28	− 3.3	+1.5
Dec. 8	Greenwich	23 Tauri	I	−0.86	−0.17	+0.12	+0.54	+0.56	−0.01	+0.19	+0.51	−0.10	− 6.2	−1.7
8	Greenwich	23 Tauri	EB	+0.74	+0.14	+0.15	+0.68	+0.70	+0.24	−0.14	+0.56	+0.09	− 1.8	−5.5
8	Greenwich	28 Tauri	I	−0.81	−0.16	+0.14	+0.61	+0.63	0.00	+0.18	+0.57	−0.09	− 5.1	−0.9
8	Greenwich	27 Tauri	I	−0.13	−0.02	+0.22	+0.96	+0.99	+0.17	+0.04	+0.85	−0.01	− 2.2	−1.5
8	Greenwich	17 Tauri	EB	+1.01	+0.19	−0.05	−0.22	−0.23	+0.10	−0.21	−0.25	+0.12	+ 1.8	−3.2
8	Greenwich	η Tauri	I	−1.00	−0.19	+0.06	+0.26	+0.27	−0.09	+0.21	+0.29	−0.12	− 3.3	+1.9
21	Cape	σ Scorpii	IB	−0.91	+0.08	+0.13	+0.34	−0.37	−0.03	−0.10	+0.34	+0.47	− 4.3	+0.4
21	Cape	α Scorpii	IB	−0.81	+0.07	−0.23	−0.51	+0.55	−0.14	−0.10	−0.45	+0.42	− 4.6	−0.4
1860, Jan. 4	Greenwich	17 Tauri	I	−0.61	−0.08	+0.19	+0.79	+0.81	+0.06	+0.14	+0.71	−0.37	− 5.2	−2.0
4	Greenwich	q Tauri	I	−0.90	−0.11	−0.12	−0.48	−0.49	−0.22	+0.17	−0.35	−0.54	− 5.7	−1.0
4	Greenwich	20 Tauri	I	−0.99	−0.12	−0.06	−0.25	−0.26	−0.11	−0.01	+0.03	−0.60	− 8.3	−3.2
6	Leiden	112 B. Aurigæ	I	−1.05	−0.50	−0.18	−0.21	−0.27	−0.20	0.00	−0.22	−0.28	− 8.1	−2.6
Feb. 13	Cape	A Scorpii	IB	−0.87	−0.21	−0.15	−0.45	+0.48	−0.18	−0.15	−0.34	+0.88	− 6.6	−2.1
28	Camb., Eng.	16 Tauri	I	−0.46	−0.02	+0.25	+0.84	+0.88	+0.13	+0.11	+0.77	−0.45	− 4.2	−1.8
28	Camb., Eng.	20 Tauri	I	−0.70	−0.03	+0.20	+0.67	+0.70	+0.06	+0.15	+0.64	−0.69	− 4.3	−0.7
28	Camb., Eng.	22 Tauri	I	−0.97	−0.04	+0.04	+0.12	+0.13	−0.06	+0.20	+0.18	−0.99	− 5.7	−0.7
28	Greenwich	q Tauri	I	−0.92	−0.04	+0.09	+0.31	+0.32	−0.02	+0.20	+0.33	−0.95	− 3.8	+1.0
28	Greenwich	16 Tauri	I	−0.39	−0.02	+0.27	+0.88	+0.92	+0.14	+0.10	+0.80	−0.40	− 2.9	−0.9
28	Greenwich	22 Tauri	I	−0.96	−0.04	+0.05	+0.16	+0.17	−0.05	+0.21	+0.11	−0.99	− 5.1	−0.1
28	Greenwich	20 Tauri	I	−0.65	−0.03	+0.21	+0.71	+0.74	+0.08	+0.15	+0.66	−0.67	− 4.7	−1.3
Mar. 1	Leiden	112 B. Aurigæ	I	−0.94	−0.42	−0.28	−0.30	−0.41	−0.13	0.00	−0.35	−0.85	− 3.1	+1.8
1	Leiden	112 B. Aurigæ	EB	+0.95	+0.42	−0.27	−0.26	−0.38	+0.13	+0.01	−0.44	+0.86	+ 2.0	−2.8
4	Leiden	δ Cancri	I	−0.95	−0.77	−0.54	−0.03	−0.54	−0.05	−0.22	−0.41	−0.44	− 4.0	+0.9
4	Leiden	δ Cancri	EB	+0.88	+0.72	−0.62	−0.03	−0.62	+0.38	+0.23	−0.55	+0.41	− 0.1	−4.5
4	Greenwich	δ Cancri	I	−0.99	−0.81	−0.47	−0.02	−0.47	−0.06	−0.32	−0.32	−0.48	− 5.1	0.0
5	Greenwich	18 Leonis	I	−1.11	−0.96	−0.20	+0.05	−0.21	−0.16	−0.42	−0.05	−0.32	− 7.8	−2.0
7	Cape	υ Leonis	IB	−0.75	−0.63	+0.55	−0.52	+0.76	−0.52	−0.20	+0.13	+0.07	− 4.1	−0.2
7	Cape	υ Leonis	E	+1.06	+0.87	+0.28	−0.27	+0.39	+0.08	+0.46	0.00	−0.09	+ 3.9	−1.4
12	Cape	α Scorpii	IB	−0.78	−0.07	−0.30	−0.55	+0.62	−0.16	−0.09	−0.53	+0.73	− 4.3	−0.2
12	Cape	α Scorpii	E	+0.92	+0.08	−0.18	−0.33	+0.37	+0.07	+0.12	−0.41	−0.86	+ 7.6	+3.0
28	Cape	354 B. Tauri	I	−0.66	−0.22	−0.49	−0.55	−0.73	−0.08	+0.02	−0.66	−0.67	+ 2.4	+5.8
Apr. 27	Cape	μ Cancri	I	−0.78	−0.59	−0.66	−0.10	−0.67	+0.06	−0.24	−0.57	−0.74	− 4.7	−0.6
May 1	Cape	υ Leonis	I	−0.96	−0.85	+0.34	−0.35	+0.49	−0.40	−0.33	+0.09	−0.62	− 5.6	−0.6
8	Cape	λ Sagittarii	E	+0.77	−0.23	+0.52	+0.33	−0.62	+0.01	−0.10	+0.66	−0.52	+ 5.2	+1.3
25	Cape	δ Cancri	I	−0.88	−0.70	+0.56	−0.02	+0.56	−0.33	−0.24	+0.42	−0.76	− 4.1	+0.5
June. 1	Leiden	50 G. Libræ	I	−0.77	−0.34	−0.18	−0.67	+0.69	−0.28	−0.16	−0.45	−0.31	− 4.9	−0.9

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1860, June 3	Cape	A^2 Ophiuchi	IB	−0.98	−0.02	−0.20	−0.20	+0.28	−0.14	−0.03	−0.23	+0.03	−7.0	−1.9
3	Cape	A^2 Ophiuchi	E	+0.84	+0.02	−0.39	−0.40	+0.56	+0.09	+0.03	−0.61	−0.02	+5.1	+0.9
3	Cape	A^1 Ophiuchi	E	+0.84	+0.02	−0.39	−0.40	+0.56	+0.09	+0.03	−0.61	−0.02	−0.6	−4.8
Aug. 24	Cape	A^1 Ophiuchi	I	−0.84	−0.18	−0.38	−0.34	+0.51	−0.09	−0.01	−0.44	−0.85	−5.0	−0.6
30	Cape	θ Aquarii	E	+0.90	−0.89	+0.11	−0.07	−0.13	−0.04	−0.43	+0.05	+0.18	+1.5	−3.0
Sept. 6	Greenwich	η Tauri	E	+0.91	−0.37	−0.09	−0.19	−0.21	0.00	−0.19	−0.26	−0.96	+5.1	+0.5
6	Greenwich	27 Tauri	E	+0.84	−0.34	+0.20	+0.40	+0.45	+0.12	−0.16	+0.32	−0.87	+4.0	−0.3
6	Greenwich	28 Tauri	E	+0.93	−0.38	+0.07	+0.14	+0.16	+0.07	−0.18	+0.06	−0.97	+6.6	+1.9
Oct. 17	Cape	22 Scorpii	I	−0.74	−0.34	+0.47	+0.54	−0.72	−0.16	+0.04	+0.63	−0.41	−4.3	−0.4
Nov. 5	Leiden	o^1 Cancri	IB	−0.94	−0.63	+0.43	−0.10	+0.44	−0.28	−0.28	+0.42	+0.90	−5.8	−0.8
5	Leiden	o^1 Cancri	E	+0.94	+0.63	+0.43	−0.11	+0.44	+0.03	+0.33	+0.26	−0.90	+4.8	0.0
5	Leiden	o^2 Cancri	IB	−0.84	−0.57	−0.57	+0.14	−0.59	+0.08	−0.32	−0.39	+0.81	−4.8	−0.4
5	Leiden	o^2 Cancri	E	+0.86	+0.58	−0.53	+0.13	−0.55	+0.29	+0.25	−0.50	−0.83	+3.6	−0.8
Dec. 19	Leiden	16 Piscium	I	−0.70	+0.76	+0.31	−0.54	−0.62	−0.27	+0.28	+0.13	−0.78	−2.8	+0.9
1861, Mar. 19	Greenwich	5 Geminor.	I	−0.70	+0.26	+0.65	+0.21	+0.68	−0.10	−0.07	+0.75	−0.72	−3.8	−0.1
Apr. 19	Leiden	o Leonis	I	−0.98	−0.60	−0.32	+0.23	−0.39	0.00	−0.39	−0.14	−0.78	−6.8	−1.6
27	Leiden	151 G. Ophiuchi	E	+1.04	+0.58	+0.26	+0.13	−0.29	+0.17	−0.01	+0.21	−0.61	+5.6	+0.3
May 19	Leiden	13 B. Virginis	I	−1.10	−0.93	+0.01	−0.03	+0.03	−0.21	−0.42	+0.10	−0.82	−8.7	−2.9
June 11	Leiden	ζ Cancri	I	−1.00	−0.18	−0.08	+0.02	−0.08	−0.07	−0.30	+0.02	−0.71	−1.7	+3.6
11	Leiden	ζ Cancri	EB	+0.98	+0.18	−0.19	+0.06	−0.19	+0.14	−0.28	−0.25	+0.70	+3.4	−1.6
25	Greenwich	18 Aquarii	IB	−0.44	+0.11	+0.76	−0.49	−0.90	−0.37	+0.10	+0.64	+0.26	−2.9	−0.6
Sept. 14	Greenwich	π Capricor.	I	−0.93	−0.17	−0.30	+0.13	+0.33	+0.02	+0.30	−0.20	−0.80	−4.6	+0.3
14	Greenwich	ρ Capricor.	I	−0.88	−0.16	+0.42	−0.18	−0.46	−0.21	+0.25	+0.45	−0.76	+3.1	+7.8
26	Leiden	9 Geminor.	E	+0.66	−0.34	−0.70	−0.09	−0.71	+0.09	+0.07	−0.77	−0.69	+4.2	+0.8
26	Leiden	11 Geminor.	E	+0.90	−0.46	+0.29	+0.03	+0.29	+0.01	+0.10	+0.20	−0.95	+5.3	+0.7
Oct. 15	Leiden	22 B. Piscium	I	−0.81	+0.51	−0.16	+0.46	+0.48	+0.19	+0.41	−0.02	−0.56	−5.7	−1.4
15	Leiden	9 Piscium	I	−0.89	+0.56	+0.07	−0.24	−0.25	−0.12	+0.38	+0.13	−0.62	−5.2	−0.5
15	Leiden	9 Piscium	EB	+0.92	−0.58	−0.01	+0.04	+0.04	+0.02	−0.40	−0.09	+0.64	+0.2	−4.5
15	Leiden	κ Piscium	I	−0.52	+0.35	+0.24	−0.80	−0.83	−0.36	+0.16	+0.19	−0.34	−1.4	+1.4
15	Leiden	κ Piscium	EB	+0.72	−0.48	+0.18	−0.60	−0.63	−0.25	−0.38	+0.05	+0.48	0.0	−3.7
19	Leiden	B.D. +18° 325	E	+0.68	−0.76	+0.36	+0.55	+0.65	+0.16	−0.18	+0.33	−0.17	+2.4	−1.1
20	Leiden	ζ Arietis	E	+0.83	−0.90	+0.27	+0.30	+0.40	+0.08	−0.19	+0.21	−0.35	+3.9	−0.3
20	Greenwich	ζ Arietis	IB	−0.89	+0.97	+0.09	+0.10	+0.14	+0.04	+0.23	+0.17	+0.36	−8.9	−4.2
22	Greenwich	103 Tauri	IB	−0.89	+0.76	−0.18	−0.07	−0.19	0.00	+0.02	−0.09	+0.74	−7.1	−2.4
Dec. 23	Leiden	e Leonis	IB	−1.03	−0.65	+0.01	−0.04	+0.04	−0.13	−0.41	+0.10	+0.99	−6.0	−0.5
1862, Feb. 4	Washington	101 Piscium	I	−0.59	+0.56	+0.31	+0.70	+0.76	+0.25	+0.27	+0.38	−0.59	−3.2	−0.1
Mar. 9	Greenwich	6 Geminor.	I	−0.87	+0.74	+0.33	0.00	+0.33	−0.03	−0.09	+0.41	−0.90	−3.7	+0.9
15	Leiden	e Leonis	IB	−1.08	−0.50	+0.01	−0.08	+0.08	−0.20	−0.40	+0.10	+0.05	−6.7	−1.0
15	Leiden	e Leonis	E	+1.06	+0.49	−0.03	+0.19	−0.19	+0.24	+0.39	−0.13	−0.05	+5.3	−0.1
Apr. 15	Leiden	43 B. Libræ	IB	−1.14	−0.95	−0.09	−0.08	+0.12	−0.26	−0.23	+0.02	+0.36	−8.4	−2.4
15	Greenwich	43 B. Libræ	E	+1.15	+0.97	−0.03	−0.03	+0.04	+0.23	+0.23	−0.24	−0.38	+7.5	+1.6
May 8	Washington	55 Leonis	I	−1.02	−0.29	+0.04	−0.12	+0.14	−0.15	−0.38	+0.13	−0.83	−6.7	−1.3
11	Washington	75 Virginis	I	−1.08	−0.78	−0.15	−0.30	+0.31	−0.32	−0.29	−0.04	−0.33	−5.2	+0.5
June 9	Radcliffe	43 B. Libræ	I	−1.14	−0.96	0.00	0.00	0.00	−0.22	−0.23	+0.11	−0.45	−4.6	+1.4
July 15	Greenwich	κ Piscium	E	+0.90	−0.06	+0.02	−0.43	−0.43	−0.10	−0.40	+0.01	−0.70	+6.0	+1.5
15	Greenwich	9 Piscium	E	+0.98	−0.07	−0.01	+0.18	+0.18	+0.15	−0.38	−0.12	−0.76	+1.0	−3.9
21	Greenwich	υ Tauri	E	+0.80	−0.88	−0.44	−0.13	−0.46	−0.05	−0.07	−0.49	−0.73	+3.4	−0.6
Aug. 1	Washington	75 Virginis	I	−1.05	−0.74	+0.01	+0.02	−0.02	−0.13	−0.33	+0.11	−0.99	−5.0	+0.5
Sept. 3	Greenwich	π Sagittarii	I	−0.19	−0.16	+0.89	−0.40	−0.98	−0.19	+0.02	+0.10	−0.15	−0.3	+0.7
Oct. 11	Greenwich	κ Tauri	IB	−0.87	+0.93	−0.28	−0.06	−0.29	−0.02	+0.10	−0.19	+0.67	−7.9	−3.4
11	Greenwich	κ Tauri	E	+0.89	−0.95	−0.18	−0.04	−0.18	−0.03	−0.08	−0.26	−0.69	+4.4	−0.1
29	Washington	τ Capricor.	I	−0.96	−0.72	+0.27	−0.29	−0.40	−0.22	−0.27	+0.40	−0.92	−3.9	+1.1
Dec. 7	Cape	μ Geminor.	E	+0.90	−0.99	+0.03	−0.01	+0.03	−0.01	+0.12	+0.04	−0.30	+5.8	−1.3
10	Greenwich	α Cancri	IB	−0.73	+0.50	+0.35	−0.50	+0.61	−0.19	−0.22	+0.53	+0.68	−9.1	−5.3
10	Greenwich	α Cancri	E	+0.86	−0.59	+0.20	−0.29	+0.35	−0.12	+0.31	+0.15	−0.80	+8.5	+4.2
13	Cape	p^5 Leonis	IB	−0.92	+0.05	−0.01	−0.31	+0.31	−0.17	−0.34	+0.14	+0.94	+1.0	+5.8
1863, Jan. 9	Leiden	55 Leonis	E	+0.95	−0.19	0.00	+0.03	−0.03	+0.04	+0.38	−0.10	−0.87	+5.6	+0.9
27	Leiden	δ Arietis	EB	+0.91	−0.66	−0.15	−0.07	−0.17	−0.03	−0.20	−0.20	+0.98	+4.7	+0.2
27	Radcliffe	δ Arietis	I	−0.84	+0.60	−0.38	−0.18	−0.42	−0.08	+0.17	−0.24	−0.90	−5.2	−0.8
27	Radcliffe	δ Arietis	EB	+0.90	−0.65	−0.19	−0.09	−0.21	−0.04	−0.19	−0.24	+0.97	+3.8	−0.7
27	Greenwich	δ Arietis	I	−0.85	+0.61	−0.38	−0.10	−0.39	−0.07	+0.17	−0.24	−0.91	−4.5	−4.7
27	Greenwich	δ Arietis	EB	+0.90	−0.65	−0.17	−0.04	−0.18	−0.04	−0.17	−0.20	+0.97	−1.0	−5.5
27	Cape	ζ Arietis	I	−0.90	+0.65	+0.15	+0.06	+0.16	+0.03	+0.19	+0.14	−0.98	−4.3	+0.4
Feb. 23	Washington	δ Arietis	I	−0.72	+0.49	−0.59	−0.26	−0.63	−0.13	+0.14	−0.41	−0.72	−0.5	+3.2
Mar. 2	Leiden	α Cancri	I	−0.87	+0.73	+0.17	−0.31	+0.35	−0.11	−0.28	+0.31	−0.42	−6.4	−1.9
2	Leiden	α Cancri	EB	+0.93	−0.78	+0.05	−0.09	+0.10	−0.03	+0.32	+0.02	+0.45	+7.7	+3.1
2	Radcliffe	α Cancri	I	−0.82	+0.69	−0.24	−0.40	+0.47	−0.15	−0.25	+0.43	−0.40	−4.4	−0.1
2	Greenwich	α Cancri	I	−0.83	+0.70	+0.23	−0.40	+0.46	−0.14	−0.14	+0.42	−0.40	−6.8	−2.5
12	Cape	58 Ophiuchi	E	+1.07	+0.98	−0.08	+0.02	+0.08	+0.15	−0.04	−0.09	−0.99	+4.3	−1.0
22	Washington	40 Arietis	I	−0.90	+0.50	−0.30	−0.16	−0.34	−0.11	+0.21	−0.18	−0.59	−6.5	−1.8

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1863, Mar. 24	Leiden	51 Tauri	I	−0.22	+0.19	−0.97	−0.10	−0.97	−0.08	+0.02	−0.85	−0.21	−3.1	−2.0
24	Leiden	53 Tauri	EB	+0.62	−0.54	+0.74	+0.07	+0.74	+0.06	−0.06	+0.61	+0.58	+5.0	+1.9
Apr. 2	Leiden	13 B. Aurigæ	I	−0.54	+0.05	−0.26	−0.80	+0.84	−0.35	−0.14	+0.11	−0.08	−2.8	0.0
7	Cape	ω Ophiuchi	IB	−0.89	−0.72	+0.57	+0.03	−0.57	−0.10	−0.07	+0.46	+0.66	−4.1	+0.4
8	Cape	58 Ophiuchi	IB	−1.07	−0.97	+0.10	−0.03	−0.11	−0.17	+0.03	+0.10	+0.92	−5.8	−0.3
9	Washington	36 Sagittarii	E	+0.91	+0.85	+0.46	−0.28	−0.54	+0.05	−0.14	+0.45	−0.84	+5.0	+0.5
21	Washington	105 Tauri	I	−0.90	+0.88	−0.19	+0.02	−0.19	0.00	0.00	−0.09	−0.70	−5.4	−0.8
25	Washington	29 Cancri	I	−0.72	+0.72	−0.34	+0.49	−0.60	+0.18	−0.24	−0.43	−0.80	−0.8	+2.9
26	Greenwich	κ Cancri	I	−0.89	+0.79	+0.10	−0.21	+0.23	−0.06	−0.30	+0.26	−0.94	−3.4	+1.1
26	Greenwich	κ Cancri	EB	+0.92	−0.81	0.00	0.00	0.00	−0.01	+0.32	−0.09	+0.97	+4.5	0.0
29	Radcliffe	e Leonis	I	−0.86	+0.20	+0.10	+0.46	−0.47	+0.13	−0.36	+0.02	−0.52	−4.6	−0.8
29	Radcliffe	e Leonis	EB	+0.74	−0.17	+0.14	+0.64	−0.65	+0.28	+0.24	−0.16	+0.43	−2.0	−5.6
30	Washington	q Virginis	I	−0.94	−0.04	−0.20	−0.35	+0.40	−0.23	−0.29	+0.02	−0.37	−3.8	+1.0
May 4	Cape	ω² Scorpii	IB	−0.55	−0.39	+0.86	+0.10	−0.87	−0.01	−0.07	+0.73	+0.18	−3.7	−0.9
June 28	Cape	ω² Scorpii	I	−0.67	−0.44	+0.79	+0.05	−0.80	−0.03	−0.09	+0.66	−0.31	−2.8	+0.6
28	Cape	ω² Scorpii	EB	+0.46	+0.30	+0.91	+0.05	−0.91	+0.18	+0.03	+0.36	+0.21	+4.8	+2.5
30	Cape	21 Sagittarii	EB	+1.09	+0.92	+0.28	−0.16	−0.32	+0.19	−0.11	+0.36	+0.06	+5.8	+0.5
July 28	Greenwich	36 Sagittarii	I	−1.07	−0.92	+0.29	+0.22	+0.36	−0.25	+0.13	+0.42	−0.36	−2.1	+3.4
Aug. 7	Leiden	ω Tauri	IB	−0.87	+0.53	+0.31	0.00	+0.31	+0.05	+0.19	+0.35	+0.92	−6.4	−2.0
27	Washington	c¹ Capricor.	I	−1.02	−0.81	+0.07	−0.43	−0.44	−0.33	+0.28	+0.32	−0.22	−4.4	+0.8
30	Washington	51 Piscium	IB	−1.03	−0.40	+0.16	+0.23	+0.28	−0.04	+0.35	+0.10	+0.33	−5.3	0.0
30	Washington	51 Piscium	E	+0.94	+0.37	+0.29	+0.40	+0.49	+0.31	−0.28	+0.02	−0.30	−5.2	−9.8
Sept. 24	Washington	51 Aquarii	I	−0.78	−0.60	−0.06	−0.70	−0.71	−0.37	−0.20	+0.36	−0.38	−0.8	+3.2
Oct. 22	Radcliffe	κ Aquarii	I	−0.96	−0.71	+0.06	+0.46	+0.46	+0.03	+0.34	−0.13	−0.72	−4.7	+0.2
23	Greenwich	16 Piscium	I	−0.51	−0.36	−0.37	−0.80	−0.88	−0.37	+0.11	−0.14	−0.31	−0.7	+1.9
23	Radcliffe	16 Piscium	I	−0.46	−0.29	−0.35	−0.83	−0.90	−0.38	+0.10	+0.13	−0.29	−1.6	+0.7
23	Leiden	16 Piscium	I	−0.59	+0.48	−0.35	−0.76	−0.83	−0.37	+0.15	+0.16	−0.37	−1.2	+1.8
30	Leiden	χ¹ Orionis	E	+0.89	−0.75	+0.23	+0.12	+0.26	−0.02	+0.05	+0.19	−0.67	+3.9	−0.4
30	Radcliffe	χ¹ Orionis	IB	−0.93	+0.77	+0.01	0.00	+0.01	0.00	−0.05	+0.08	+0.69	−8.5	−3.8
30	Radcliffe	χ¹ Orionis	E	+0.91	−0.75	+0.18	−0.10	+0.21	−0.01	+0.05	+0.14	−0.68	+5.9	+1.5
30	Greenwich	χ¹ Orionis	E	+0.93	−0.75	+0.06	−0.03	+0.07	+0.02	+0.05	+0.17	−0.67	+4.2	−0.2
Nov 3	Washington	ω Leonis	IB	−0.86	+0.91	+0.05	−0.30	+0.31	−0.07	−0.28	+0.26	+0.94	−3.6	+0.7
17	Cape	ξ Aquarii	I	−1.04	−0.94	−0.02	+0.26	+0.26	−0.06	+0.33	−0.54	−0.97	−3.3	+1.9
19	Washington	9 Piscium	I	−0.92	−0.67	−0.17	−0.40	−0.44	−0.24	+0.29	+0.13	−0.86	−2.1	+2.5
19	Washington	κ Piscium	I	−0.35	−0.25	−0.37	−0.86	−0.94	−0.37	+0.06	+0.18	−0.31	+0.3	+2.0
19	Leiden	κ Piscium	I	−1.00	−0.71	−0.12	−0.28	−0.30	−0.22	+0.28	+0.12	−0.90	−4.6	+0.4
19	Leiden	9 Piscium	I	−1.01	−0.72	+0.12	+0.26	+0.28	−0.01	+0.36	+0.01	−0.91	−4.6	+0.5
30	Leiden	60 Cancri	IB	−0.88	+0.98	−0.07	+0.21	−0.22	+0.10	−0.30	−0.14	+0.87	−8.2	−3.8
30	Leiden	60 Cancri	E	+0.89	−0.99	−0.05	+0.15	−0.16	+0.01	+0.28	−0.14	−0.88	+4.7	+0.4
Dec. 19	Radcliffe	π Piscium	I	−0.74	−0.20	+0.57	+0.36	+0.67	+0.15	+0.25	+0.32	−0.67	−5.4	−1.7
24	Leiden	χ² Orionis	EB	+0.92	−0.72	+0.08	−0.06	+0.10	−0.02	+0.07	+0.02	+0.14	−2.3	−6.7
27	Leiden	A¹ Cancri	IB	−0.89	+0.99	−0.05	+0.13	−0.14	+0.07	−0.27	−0.04	+0.50	−7.1	−2.6
27	Leiden	A¹ Cancri	E	+0.86	−0.96	−0.08	+0.27	−0.28	+0.05	+0.26	−0.30	−0.51	+4.1	0.0
27	Leiden	A² Cancri	IB	−0.74	+0.82	+0.16	−0.54	+0.56	−0.13	−0.22	+0.50	+0.42	−7.5	−3.8
27	Leiden	A² Cancri	E	+0.84	−0.94	+0.09	−0.32	+0.33	−0.13	+0.28	+0.18	−0.50	+3.5	−0.5
30	Leiden	p³ Leonis	E	+0.91	−0.77	+0.01	+0.04	−0.04	−0.01	+0.34	+0.06	−0.94	+5.6	+1.2
1864, Jan. 24	Leiden	κ Cancri	IB	−0.70	+0.78	+0.12	−0.62	+0.63	−0.16	+0.20	+0.51	+0.16	−8.9	−5.4
24	Leiden	κ Cancri	E	+0.64	−0.71	+0.13	−0.69	+0.70	−0.23	+0.24	+0.45	−0.14	+0.2	−2.9
Feb. 13	Washington	53 Arietis	I	−0.84	−0.08	−0.54	−0.06	−0.54	−0.16	+0.15	−0.34	−0.79	−4.2	0.0
14	Washington	43 Tauri	I	−0.54	+0.11	+0.81	−0.13	+0.82	+0.08	+0.06	+0.78	−0.57	−4.1	−1.4
14	Washington	43 Tauri	EB	+0.70	−0.14	+0.67	−0.12	+0.68	+0.08	−0.08	+0.56	+0.73	−2.3	−5.6
16	Washington	χ Orionis	I	−0.91	+0.58	+0.11	−0.07	+0.13	+0.02	−0.05	+0.19	−0.90	−5.9	−1.3
16	Washington	χ Orionis	EB	+0.91	+0.58	−0.10	−0.07	−0.12	−0.02	+0.05	−0.11	+0.90	0.0	−4.3
25	Washington	49 Virginis	E	+0.06	−0.03	+0.82	+0.57	−1.00	+0.30	−0.03	+0.30	−0.05	−0.3	−0.6
29	Cape	ψ Ophiuchi	IB	−1.00	−0.44	−0.13	+0.03	+0.13	−0.09	−0.09	−0.06	+0.98	−8.1	−3.1
29	Cape	ψ Ophiuchi	E	+1.01	+0.44	+ .12	−0.03	−0.12	+0.10	+0.09	+0.04	−0.98	−6.3	−11.1
Mar. 18	Greenwich	A¹ Cancri	IB	−0.68	+0.74	−0.16	+0.63	−0.65	+0.22	−0.23	−0.44	−0.57	−5.5	−2.2
18	Greenwich	A² Cancri	I	−0.89	+0.97	+0.03	−0.13	+0.13	0.00	−0.26	+0.18	−0.74	−6.3	−1.9
18	Radcliffe	A² Cancri	I	−0.89	+0.97	+0.03	−0.14	+0.14	0.00	−0.26	+0.19	−0.74	−6.0	−1.6
18	Leiden	A² Cancri	I	−0.90	+0.98	+0.01	−0.03	+0.03	+0.03	−0.26	+0.09	−0.75	−8.2	−3.8
18	Leiden	A² Cancri	EB	+0.87	−0.95	−0.05	+0.22	−0.23	+0.03	+0.26	−0.26	+0.73	+3.4	−0.7
19	Leiden	ω Leonis	I	−0.90	+1.00	0.00	+0.08	−0.08	+0.05	−0.31	+0.01	−0.62	−6.6	−2.2
19	Leiden	ω Leonis	EB	+0.88	−0.98	−0.01	+0.21	−0.21	+0.03	+0.29	−0.20	+0.61	−2.6	−6.7
19	Radcliffe	ω Leonis	EB	+0.89	−0.99	−0.01	+0.13	−0.13	0.00	+0.30	−0.16	+0.63	−0.1	−4.3
19	Greenwich	ω Leonis	I	−0.90	+1.00	0.00	+0.03	−0.03	+0.04	−0.31	+0.05	−0.64	−5.5	−1.1
24	Cape	α Virginis	IB	−0.77	+0.30	−0.51	−0.29	+0.59	−0.19	−0.20	−0.18	+0.34	−6.3	−2.5
24	Cape	α Virginis	E	+0.92	−0.36	−0.21	−0.11	+0.23	−0.05	+0.30	−0.13	−0.41	+5.3	+1.0
27	Cape	ν Scorpii	IB	−0.67	−0.22	+0.73	−0.16	−0.75	+0.02	−0.09	+0.61	+0.60	−5.1	−1.8
Apr. 11	Radcliffe	57 Orionis	E	+0.86	−0.49	−0.35	+0.26	−0.44	+0.04	+0.05	−0.51	+0.83	−0.3	−4.3
20	Leiden	49 Virginis	I	−0.87	+0.46	+0.35	+0.23	−0.41	+0.11	−0.30	+0.18	−0.11	−4.2	+0.1

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1864, Apr. 20	Leiden	49 Virginis	E	+0.74	−0.38	+0.55	+0.34	−0.64	+0.21	+0.20	+0.12	+0.09	−0.2	−3.7
23	Leiden	λ Libræ	I	−0.98	−0.17	+0.25	−0.04	−0.25	−0.04	−0.13	+0.29	+0.49	−7.9	−3.1
27	Cape	e Sagittarii	E	+0.88	+0.74	+0.25	−0.50	−0.56	0.00	−0.18	+0.52	−0.81	+6.6	+2.5
May 20	Washington	χ Libræ	I	−0.96	−0.08	+0.35	−0.05	−0.36	−0.03	−0.15	+0.32	+0.03	−1.7	+3.0
June 20	Washington	d Sagittarii	IB	−0.04	−0.03	−0.51	+0.86	+1.00	+0.14	+0.02	−1.00	+0.01	−2.7	−2.5
26	Greenwich	62 Piscium	E	+0.80	+0.61	+0.54	+0.36	+0.65	+0.30	−0.22	+0.11	−0.75	−0.1	−3.8
26	Greenwich	δ Piscium	IB	−1.00	−0.75	−0.27	−0.18	−0.32	−0.21	+0.29	−0.01	+0.94	−8.7	−3.9
26	Greenwich	δ Piscium	E	+1.04	+0.78	−0.14	−0.10	−0.17	+0.06	0.00	−0.09	−0.98	+7.8	+3.0
July 18	Cape	e Sagittarii	I	−0.98	−0.70	+0.19	−0.46	−0.50	−0.27	+0.15	+0.45	−0.02	−4.8	−0.1
18	Cape	e Sagittarii	E	+1.10	+0.78	+0.08	−0.20	−0.21	+0.15	−0.19	+0.16	+0.02	+5.2	+0.1
23	Washington	62 Piscium	E	+0.46	+0.37	−0.76	+0.50	+0.90	+0.34	−0.09	+0.16	−0.40	+1.9	−0.2
23	Washington	δ Piscium	IB	−1.07	−0.83	−0.09	−0.06	−0.10	−0.17	+0.31	+0.03	+0.91	−5.6	−0.5
23	Washington	δ Piscium	E	+1.05	+0.81	+0.19	+0.12	+0.23	+0.21	−0.30	−0.01	−0.88	+4.0	−0.8
Aug. 12	Washington	ξ Ophiuchi	I	−1.01	−0.07	−0.20	+0.14	+0.24	−0.10	−0.02	−0.18	−0.79	−5.4	−0.6
Nov. 4	Washington	ρ Sagittarii	I	−0.95	−0.58	−0.14	+0.36	+0.39	−0.03	+0.15	−0.33	−0.86	−2.2	+2.3
5	Washington	16 B. Capricor.	I	−0.82	−0.62	−0.07	+0.62	+0.63	+0.06	+0.21	−0.48	−0.77	−4.3	−0.4
5	Washington	β Capricor.	I	−0.76	−0.57	−0.08	+0.69	+0.70	+0.07	−0.18	−0.56	−0.71	−4.5	−0.9
10	Leiden	62 Piscium	I	−1.07	−0.86	−0.26	−0.13	−0.29	−0.26	+0.28	−0.02	−0.60	−8.3	−3.2
10	Leiden	62 Piscium	EB	+1.08	+0.87	−0.21	−0.10	−0.23	+0.09	−0.32	−0.08	+0.60	+1.3	−3.6
19	Leiden	κ Cancri	IB	−0.68	+0.61	+0.06	+0.67	−0.67	+0.20	−0.23	−0.44	+0.70	−4.6	−1.4
19	Leiden	κ Cancri	E	+0.72	−0.63	+0.06	+0.62	−0.62	+0.15	+0.19	−0.49	−0.74	+3.6	+0.4
Dec. 5	Greenwich	κ Aquarii	I	−0.83	−0.76	−0.33	−0.55	−0.64	−0.31	+0.21	+0.29	−0.77	−2.1	+1.8
6	Cape	κ Piscium	I	−1.06	−1.00	+0.06	+0.06	+0.08	−0.11	+0.35	+0.06	−1.00	−3.9	+1.1
6	Cape	κ Piscium	EB	+1.00	+0.93	+0.25	+0.26	+0.37	+0.26	−0.28	−0.12	+0.93	0.0	−4.5
1865, Jan. 8	Leiden	302 B. Tauri	I	−0.77	−0.22	+0.54	−0.37	+0.67	−0.02	+0.06	+0.67	−0.52	−5.1	−1.5
8	Leiden	i Tauri	I	−0.57	−0.14	+0.67	−0.49	+0.83	+0.02	+0.04	+0.82	−0.36	−5.1	−2.4
12	Washington	A^1 Cancri	IB	−0.94	+0.66	0.00	+0.05	−0.05	+0.02	0.00	+0.01	+0.20	−5.8	−1.4
Feb. 2	Washington	σ Arietis	IB	−1.00	−0.69	+0.30	−0.05	+0.31	−0.03	+0.22	+0.25	+0.80	−6.3	−1.6
9	Leiden	κ Cancri	I	−0.92	+0.71	−0.02	−0.10	+0.10	−0.01	−0.76	+0.12	−0.16	−5.2	−0.9
Mar. 3	Greenwich	68 Tauri	I	−0.74	−0.35	+0.58	−0.38	+0.69	0.00	+0.07	+0.65	−0.71	−5.2	−1.8
15	Cape	λ Virginis	IB	−0.55	+0.46	−0.80	+0.04	+0.80	−0.18	−0.11	−0.43	+0.43	−3.3	−0.8
15	Cape	λ Virginis	E	+0.65	−0.55	−0.69	+0.04	+0.70	−0.20	+0.21	−0.42	−0.52	−0.2	−3.1
Apr. 30	Leiden	67 Geminor.	I	−0.96	−0.98	−0.03	+0.18	−0.18	0.00	−0.16	−0.12	−0.89	−2.8	+1.6
July 3	Greenwich	α Libræ	I	−0.62	+0.54	−0.71	+0.21	+0.74	−0.15	−0.12	−0.47	−0.54	−4.7	−1.9
3	Greenwich	α Libræ	EB	+0.63	−0.56	−0.71	+0.21	+0.74	−0.17	+0.16	−0.54	+0.56	+2.1	−0.6
3	Leiden	8 Libræ	I	−0.75	+0.66	−0.57	+0.17	+0.59	−0.11	−0.17	−0.34	−0.66	−5.0	−1.6
3	Leiden	α Libræ	I	−0.63	+0.57	−0.69	+0.21	+0.72	−0.13	−0.14	−0.44	−0.57	−4.3	−1.5
8	Leiden	ρ Sagittarii	IB	−0.70	−0.12	+0.12	−0.73	−0.74	−0.16	+0.09	+0.71	+0.06	−4.0	−0.9
Aug. 6	Leiden	8 Aquarii	IB	−0.92	−0.44	+0.16	+0.51	+0.54	+0.01	+0.22	−0.37	+0.01	−4.9	−0.8
Sept. 11	Washington	115 Tauri	E	+0.49	−0.28	+0.48	−0.74	+0.88	+0.06	−0.01	+0.86	−0.47	+2.2	+0.1
29	Washington	16 B. Capricor.	I	−1.00	−0.30	+0.05	+0.25	+0.25	−0.03	+0.21	−0.18	−0.83	−3.5	+0.9
29	Washington	β Capricor.	I	−0.98	−0.29	+0.06	+0.30	+0.31	−0.02	+0.19	−0.24	−0.82	−3.6	+0.7
Oct. 4	Leiden	147 B. Piscium	IB	−1.14	−0.96	−0.18	−0.04	−0.18	−0.26	+0.29	−0.02	−0.04	−8.3	−3.3
Nov. 4	Greenwich	64 Tauri	E	+0.76	+0.54	−0.52	+0.53	−0.74	+0.05	−0.08	−0.61	−0.20	−0.1	−3.2
5	Leiden	115 Tauri	IB	−1.03	−0.61	+0.17	−0.17	+0.33	−0.12	+0.03	+0.37	+0.47	−4.8	−0.3
5	Leiden	115 Tauri	E	+0.97	+0.57	+0.24	−0.41	+0.47	+0.14	−0.02	+0.43	−0.44	+3.1	−0.9
Dec. 30	Greenwich	115 Tauri	I	−0.81	−0.51	+0.31	−0.60	+0.67	−0.08	+0.02	+0.68	−0.29	−4.2	−0.7
1866, Jan. 8	Radcliffe	h Virginis	IB	−0.05	+0.06	−0.99	+0.10	+1.00	−0.28	+0.03	−0.40	+0.06	−2.0	−1.8
8	Radcliffe	h Virginis	E	+0.23	−0.24	−0.97	+0.10	+0.97	−0.28	+0.11	−0.40	−0.25	−0.6	−1.5
Feb. 27	Radcliffe	h Leonis	I	−0.96	+0.25	−0.11	−0.16	+0.20	−0.08	−0.25	+0.16	−0.32	−6.7	−2.6
Apr. 20	Washington	68 Geminor.	I	−1.03	−0.48	+0.02	+0.11	−0.11	−0.07	−0.15	−0.08	−0.97	−4.1	−0.2
May 11	Cape	ζ Piscium	IB	−1.12	−0.91	−0.08	+0.01	−0.08	−0.20	+0.29	−0.03	+0.47	−8.7	−4.1
20	Cape	o Leonis	I	−0.06	0.00	−0.69	−0.72	+1.00	−0.26	+0.02	+0.62	−0.05	−3.6	−3.3
June 18	Washington	75 Leonis	I	−0.68	+0.26	+0.66	+0.26	−0.70	+0.21	−0.26	−0.13	−0.68	−3.1	−0.3
July 8	Cape	68 Tauri	E	+1.11	+0.97	+0.04	−0.06	+0.07	+0.18	−0.12	+0.09	−0.66	+8.0	+3.7
26	Cape	e Sagittarii	I	−0.93	+0.46	+0.07	+0.24	+0.25	+0.02	+0.13	−0.18	−0.14	−6.6	−2.8
26	Cape	e Sagittarii	EB	+0.95	−0.46	−0.05	−0.16	−0.17	0.00	−0.13	+0.13	+0.14	−1.9	−5.6
31	Washington	44 Piscium	IB	−0.93	−0.48	−0.46	−0.03	−0.46	−0.23	+0.25	−0.04	+0.60	+3.9	+7.7
31	Washington	44 Piscium	E	+0.97	+0.63	−0.38	−0.01	−0.38	−0.03	−0.31	−0.03	−0.79	−7.0	−10.8
Aug. 29	Cape	o Piscium	E	+1.07	+0.85	−0.11	+0.04	−0.12	+0.10	−0.29	−0.03	−0.75	+6.5	+2.3
Sept. 15	Cape	φ Ophiuchi	I	−0.44	+0.48	+0.38	−0.78	−0.87	+0.12	−0.08	+0.79	−0.46	−0.4	+1.4
15	Cape	φ Ophiuchi	EB	+0.49	−0.53	+0.36	−0.76	−0.84	+0.07	+0.05	+0.77	+0.52	+2.0	+0.1
28	Greenwich	75 Tauri	E	+1.08	+0.98	−0.08	+0.16	−0.18	+0.12	−0.14	−0.15	−0.82	+4.6	+0.4
28	Greenwich	α Tauri	E	+1.00	+0.91	+0.17	−0.38	+0.42	+0.16	−0.13	+0.39	−0.76	+3.8	−0.1
28	Leiden	99 Tauri	IB	−0.94	−0.85	+0.23	−0.47	+0.52	−0.14	−0.04	+0.51	+0.70	−9.1	−5.3
28	Leiden	α Tauri	IB	−1.03	−0.94	+0.15	−0.32	+0.35	−0.10	+0.12	+0.31	+0.80	−3.7	+0.4
29	Leiden	111 Tauri	IB	−0.93	−0.83	−0.12	+0.49	−0.51	−0.14	+0.05	−0.48	+0.79	−10.0	−6.3
29	Leiden	111 Tauri	E	+1.00	+0.90	−0.09	+0.37	−0.38	+0.10	−0.05	−0.39	−0.86	+3.3	−0.5
29	Leiden	117 Tauri	IB	−0.99	−0.88	+0.09	−0.38	+0.39	−0.10	+0.05	+0.40	−0.85	−4.3	−0.3
29	Leiden	117 Tauri	E	+0.92	+0.82	+0.12	−0.52	+0.53	+0.14	−0.04	+0.50	−0.78	+3.4	−0.1

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1866, Nov. 16	Greenwich	67 Aquarii	I	−0.86	−0.12	+0.47	+0.19	+0.51	+0.10	+0.18	−0.20	−0.81	−3.0	+0.4
20	Greenwich	ξ Arietis	I	−1.03	−0.79	−0.34	+0.24	−0.42	−0.29	+0.22	−0.24	−0.32	−3.4	+0.7
27	Greenwich	o Leonis	E	+0.97	+0.39	−0.26	−0.20	+0.33	−0.01	+0.24	+0.20	−0.86	+3.8	+0.1
Dec. 24	Washington	ξ Leonis	IB	−0.37	−0.20	+0.73	+0.59	−0.94	+0.18	−0.11	−0.60	+0.21	−5.5	−4.1
24	Washington	ξ Leonis	E	+0.39	+0.45	+0.73	+0.23	−0.93	+0.27	+0.06	−0.59	−0.58	+9.0	+7.5
1867, Jan. 29	Cape	φ Ophiuchi	E	+0.29	−0.33	−0.32	+0.89	+0.94	−0.14	+0.05	−0.86	−0.29	+1.0	−0.1
Apr. 8	Washington	318 B. Tauri	I	−1.09	−0.98	−0.02	+0.12	−0.12	−0.17	+0.11	−0.13	−0.82	−4.2	−0.1
16	Cape	η Virginis	I	−0.83	+0.08	+0.51	−0.11	−0.52	+0.13	−0.28	0.00	−0.38	−1.6	+1.5
16	Cape	η Virginis	EB	+0.70	−0.06	+0.68	−0.15	−0.70	+0.24	+0.18	+0.05	+0.32	−1.5	−4.0
18	Washington	96 Virginis	IB	−0.87	+0.52	−0.30	+0.25	+0.39	−0.10	−0.24	−0.22	+0.01	−4.2	−0.9
18	Washington	96 Virginis	E	+0.95	−0.56	−0.06	+0.04	+0.08	−0.02	+0.28	−0.21	−0.01	−2.8	−6.1
May 5	Washington	α Tauri	I	−1.10	−0.93	+0.05	−0.23	+0.25	−0.15	+0.12	+0.23	−0.40	−0.1	+4.0
5	Washington	α Tauri	EB	+1.13	+0.96	+0.01	−0.07	+0.07	+0.19	−0.14	+0.08	+0.41	+3.2	−0.8
June 14	Greenwich	49 Libræ	I	−0.85	+0.72	+0.19	−0.55	−0.58	+0.04	−0.17	+0.43	−0.38	−2.2	+0.9
July 9	Washington	κ Virginis	I	−0.89	+0.39	−0.22	+0.22	+0.31	−0.08	−0.26	−0.10	−0.94	−3.9	−0.7
9	Washington	κ Virginis	EB	+0.93	−0.41	−0.06	+0.06	+0.09	−0.04	+0.28	0.00	+0.99	−0.1	−3.3
Oct. 16	Leiden	85 Tauri	E	+1.04	+0.79	+0.03	−0.27	+0.27	+0.17	−0.14	+0.28	−0.66	+3.9	+0.4
Nov. 6	Radcliffe	λ Aquarii	I	−0.95	+0.50	−0.10	0.00	−0.10	−0.04	+0.29	−0.01	−0.23	−3.6	−0.3
8	Radcliffe	10 Ceti	I	−1.01	+0.12	−0.09	+0.04	−0.10	−0.10	+0.31	−0.06	−0.61	−4.4	−0.9
8	Greenwich	10 Ceti	I	−1.00	+0.12	−0.06	+0.03	−0.07	−0.08	+0.32	−0.05	−0.61	−2.2	+1.3
Dec. 28	Cape	τ Capricor.	I	−0.50	+0.54	−0.71	−0.44	−0.83	−0.11	+0.08	+0.67	−0.30	−0.5	+1.2
1868, Feb. 8	Leiden	A Leonis	E	+0.93	+0.74	−0.58	−0.07	+0.58	+0.01	+0.23	+0.32	−0.07	+5.0	+2.0
11	Leiden	k Virginis	E	+0.79	+0.28	−0.52	+0.40	+0.66	−0.14	+0.29	−0.13	−0.53	−0.9	−3.3
28	Leiden	μ Ceti	I	−0.47	−0.15	+0.36	−0.81	+0.89	+0.20	+0.15	+0.55	−0.42	−3.2	−1.6
28	Leiden	μ Ceti	EB	+0.54	+0.17	+0.34	−0.77	+0.84	+0.26	−0.12	+0.57	+0.51	−2.4	−4.1
28	Greenwich	μ Ceti	I	−0.35	−0.10	+0.40	−0.85	+0.94	+0.23	+0.13	+0.59	−0.32	−1.5	−0.3
29	Göttingen	f Tauri	I	−0.42	−0.20	+0.20	−0.89	+0.91	+0.18	+0.12	+0.69	−0.42	−2.4	−1.0
Mar. 1	Leiden	71 Tauri	I	−0.84	−0.55	−0.01	−0.59	+0.59	+0.02	+0.15	+0.50	−0.81	−4.2	−1.4
1	Leiden	70 Tauri	EB	+0.80	+0.59	+0.01	+0.64	−0.64	−0.03	−0.14	−0.55	+0.77	−4.5	−7.0
1	Leiden	θ^2 Tauri	I	−1.04	−0.68	0.00	−0.07	+0.07	−0.08	+0.16	+0.04	−1.00	−4.7	−1.3
1	Leiden	θ^2 Tauri	EB	+1.03	+0.68	0.00	−0.09	+0.09	+0.10	−0.17	+0.12	+1.00	+2.8	−0.4
1	Leiden	264 B. Tauri	I	−0.56	−0.36	+0.03	+0.84	−0.84	−0.18	+0.07	−0.79	−0.53	−2.3	−0.5
1	Leiden	θ^1 Tauri	I	−1.00	−0.65	+0.01	+0.27	−0.27	−0.14	+0.16	−0.29	−0.96	−2.1	+1.2
1	Leiden	θ^1 Tauri	EB	+1.00	+0.66	+0.01	+0.26	−0.26	+0.04	−0.17	−0.20	+0.97	+3.5	+0.4
1	Leiden	85 Tauri	I	−0.84	−0.55	−0.02	−0. 8	+0.58	+0.02	+0.15	+0.51	−0.81	−4.3	−1.5
1	Göttingen	264 B. Tauri	I	−0.58	−0.38	+0.03	+0.83	−0.83	−0.19	+0.08	−0.78	−0.56	−2.0	−0.1
1	Göttingen	85 Tauri	I	−0.84	−0.55	−0.02	−0.59	+0.59	+0.01	+0.14	+0.52	−0.81	−4.0	−1.2
1	Göttingen	θ^1 Tauri	I	−1.01	−0.66	+0.01	+0.23	−0.23	−0.13	+0.15	−0.24	−0.97	−3.0	+0.3
1	Göttingen	θ^2 Tauri	I	−1.03	−0.67	0.00	−0.12	+0.12	−0.07	+0.17	+0.07	−0.99	−3.0	+0.4
1	Greenwich	θ^2 Tauri	I	−1.04	−0.68	0.00	−0.09	+0.09	−0.07	+0.18	+0.04	−1.00	−3.0	+0.4
1	Greenwich	θ^1 Tauri	I	−1.00	−0.66	+0.01	+0.26	−0.26	−0.13	+0.16	−0.27	−0.97	−2.6	+0.7
28	Leiden	γ Tauri	I	−1.01	−0.58	0.00	+0.20	−0.20	−0.12	+0.19	−0.21	−0.87	−3.8	−0.6
Apr. 4	Cape	χ Leonis	I	−0.99	−0.73	−0.41	+0.07	+0.41	−0.26	−0.25	+0.10	−0.51	−2.0	+1.2
May 4	Greenwich	l Virginis	I	−1.04	−0.33	−0.01	+0.01	+0.02	−0.10	−0.31	+0.11	−0.45	−2.7	+0.6
4	Leiden	l Virginis	I	−1.03	−0.33	+0.06	−0.07	−0.09	−0.06	−0.33	0.00	−0.45	−0.7	+2.6
22	Washington	α Tauri	I	−0.96	−0.48	−0.06	−0.47	+0.47	−0.06	+0.15	+0.39	−0.17	−1.3	+1.7
27	Greenwich	18 Leonis	I	−1.04	−0.94	−0.05	−0.28	+0.29	−0.22	−0.23	+0.16	−0.93	−4.1	−0.8
June 24	Washington	49 Leonis	I	−0.69	−0.59	−0.77	+0.09	+0.78	−0.31	−0.14	+0.30	−0.53	−0.8	+1.1
July 1	Washington	24 Scorpii	I	−0.75	+0.28	−0.11	−0.61	−0.62	+0.09	+0.15	+0.53	−0.53	−1.1	+1.2
Aug. 9	Cape	ξ^1 Ceti	IB	−0.91	+0.13	+0.13	−0.29	+0.32	+0.07	+0.30	+0.09	+0.93	−0.1	+2.7
Sept. 4	Leiden	33 Ceti	IB	−0.93	+0.50	+0.10	−0.12	+0.15	+0.05	+0.33	−0.03	+0.58	−4.1	−1.2
6	Leiden	μ Ceti	IB	−0.69	+0.05	−0.18	+0.68	−0.70	−0.22	+0.17	−0.50	+0.62	+4.7	+6.8
7	Radcliffe	f Tauri	IB	−0.78	−0.13	−0.38	+0.46	−0.60	−0.17	+0.18	−0.52	+0.76	−2.6	−0.2
8	Radcliffe	θ^2 Tauri	IB	−0.97	−0.36	+0.06	+0.28	−0.29	−0.12	+0.17	−0.32	+0.96	−2.8	+0.2
8	Radcliffe	θ^1 Tauri	IB	−0.78	−0.28	+0.13	+0.63	−0.64	−0.16	+0.13	−0.63	+0.77	−0.5	+1.9
8	Leiden	71 Tauri	IB	−0.99	−0.37	−0.03	−0.15	+0.15	−0.03	+0.20	+0.08	+0.99	−5.3	−2.2
8	Leiden	71 Tauri	E	+0.95	+0.35	−0.06	−0.31	+0.32	+0.11	−0.15	+0.35	−0.95	+2.3	−0.5
8	Leiden	θ^2 Tauri	IB	−0.98	−0.36	+0.04	+0.22	−0.22	−0.11	+0.18	−0.26	+0.97	−2.4	+0.6
8	Leiden	264 B. Tauri	I	−0.47	−0.17	+0.18	+0.86	−0.88	−0.17	+0.07	−0.83	+0.47	−2.7	−1.3
8	Leiden	264 B. Tauri	E	+0.66	+0.24	+0.16	+0.74	−0.76	−0.09	−0.13	−0.66	−0.66	+0.9	−1.0
8	Leiden	85 Tauri	E	+0.60	+0.22	−0.17	−0.79	+0.81	+0.18	−0.09	+0.77	−0.59	+2.4	+0.6
8	Leiden	α Tauri	IB	−0.58	−0.21	+0.19	+0.79	−0.82	−0.18	+0.09	−0.78	+0.57	−1.5	+0.2
8	Leiden	α Tauri	E	+0.67	+0.25	+0.18	+0.73	−0.75	−0.09	−0.12	−0.67	−0.67	+0.4	−1.5
8	Göttingen	α Tauri	IB	−0.68	−0.25	+0.17	+0.72	−0.74	−0.17	+0.11	−0.71	+0.67	−2.6	−0.5
8	Göttingen	α Tauri	E	+0.73	+0.27	+0.16	+0.67	−0.69	−0.07	−0.14	−0.63	−0.72	+0.9	−1.2
9	Leiden	115 Tauri	E	+0.86	+0.47	+0.24	+0.51	−0.56	+0.02	−0.09	−0.50	−0.82	+1.8	−0.7
9	Radcliffe	111 Tauri	IB	−0.42	−0.23	−0.38	−0.83	+0.91	+0.07	+0.05	+0.87	+0.90	−4.3	−3.0
28	Washington	64 Aquarii	I	−0.35	+0.38	−0.90	+0.19	−0.92	−0.24	+0.08	+0.36	−0.23	−0.6	+0.5
1869, Jan. 23	Leiden	θ^1 Tauri	EB	+0.90	+0.06	−0.15	−0.45	+0.48	+0.16	−0.16	+0.49	+0.58	−4.1	−6.5
23	Leiden	θ^2 Tauri	EB	+0.61	+0.04	−0.26	−0.76	+0.81	+0.21	−0.10	+0.77	+0.39	−0.7	−2.3

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													"	"
1869, Jan. 23	Leiden	264 B. Tauri	I	−1.02	−0.07	+0.01	+0.04	−0.04	−0.09	+0.19	+0.49	−0.66	−4.7	−1.8
23	Vienna	θ¹ Tauri	I	−0.77	−0.05	−0.20	−0.62	+0.65	+0.07	+0.18	+0.54	−0.50	−4.7	−2.5
23	Vienna	264 B. Tauri	I	−0.97	−0.07	−0.11	−0.31	+0.33	−0.02	+0.19	+0.25	−0.63	−0.8	+2.0
23	Vienna	α Tauri	I	−0.97	−0.07	−0.11	−0.29	+0.31	−0.02	+0.17	+0.24	−0.63	−0.9	+1.9
24	Leiden	119 Tauri	I	−0.74	−0.21	+0.40	+0.60	−0.72	−0.17	+0.08	−0.42	−0.34	−2.8	−0.7
24	Leiden	120 Tauri	I	−0.99	−0.28	+0.20	+0.30	−0.36	−0.15	+0.11	−0.75	−0.46	−3.9	−1.0
24	Greenwich	120 Tauri	I	−0.99	−0.28	+0.20	+0.30	−0.36	−0.15	+0.10	−0.42	−0.46	−3.5	−0.6
24	Greenwich	119 Tauri	I	−0.73	−0.20	−0.41	−0.61	+0.73	−0.16	+0.07	−0.77	−0.33	−3.3	−1.2
24	Radcliffe	119 Tauri	I	−0.70	−0.28	+0.43	+0.62	−0.75	−0.16	+0.07	−0.78	−0.32	−4.0	−2.0
24	Radcliffe	119 Tauri	EB	+0.80	+0.32	+0.38	+0.55	−0.67	+0.03	−0.09	−0.61	+0.37	−1.5	−3.7
28	Washington	α Leonis	E	+1.09	+0.94	+0.31	−0.06	−0.37	+0.28	+0.25	−0.13	−0.32	+2.5	−0.4
Feb. 15	Washington	29 Ceti	I	−0.91	+0.75	0.00	0.00	+0.01	+0.04	+0.33	−0.07	−0.81	−3.4	−0.9
15	Washington	33 Ceti	I	−0.74	+0.62	−0.29	+0.49	−0.58	−0.17	+0.25	−0.21	−0.66	−1.4	+0.7
19	Washington	75 Tauri	I	−0.96	−0.05	−0.08	−0.21	+0.22	0.00	+0.19	+0.15	−0.94	−1.6	+1.1
Mar. 23	Cape	δ Cancri	I	−0.77	−0.58	+0.70	+0.09	−0.71	−0.01	−0.13	−0.53	−0.36	−1.7	+0.4
23	Cape	δ Cancri	EB	+0.50	+0.37	+0.89	+0.10	−0.89	+0.22	+0.06	−0.74	+0.23	+1.4	+0.1
Apr. 16	Vienna	119 Tauri	I	−0.73	−0.16	−0.43	−0.53	+0.68	+0.03	+0.09	+0.61	−0.66	−3.5	−1.5
May 18	Leipzig	α Leonis	I	−0.52	−0.46	−0.84	+0.25	+0.87	−0.29	−0.09	+0.44	−0.48	−1.1	+0.3
18	Kremsmunster	α Leonis	I	−0.42	−0.37	−0.88	+0.27	+0.92	−0.30	−0.07	+0.47	−0.39	−3.7	−2.6
18	Kremsmunster	α Leonis	EB	+0.57	+0.50	−0.81	+0.25	+0.85	−0.15	+0.18	+0.47	+0.53	+1.1	−0.3
Aug 2	Göttingen	α Tauri	E	+0.90	+0.19	−0.20	−0.33	+0.39	+0.10	−0.17	+0.42	−0.76	+6.6	+4.4
2	Greenwich	α Tauri	E	+0.94	+0.20	−0.14	−0.25	+0.29	+0.10	−0.19	+0.35	−0.80	+5.1	+2.9
2	Radcliffe	α Tauri	E	+0.94	+0.20	−0.14	−0.23	+0.27	+0.09	−0.19	+0.33	−0.80	+4.2	+2.0
13	Radcliffe	13 Libræ	I	−0.42	−0.35	−0.11	−0.88	−0.89	+0.27	−0.18	+0.58	−0.07	+0.5	+1.6
19	Cape	ρ Capricor.	I	0.00	0.00	−1.00	−0.04	−1.00	−0.13	−0.01	+0.84	0.00	−1.3	−1.3
19	Cape	ρ Capricor.	EB	+0.27	−0.14	−0.96	−0.04	−0.96	−0.12	−0.05	+0.82	+0.14	−2.5	−3.1
29	Cape	δ Tauri	IB	−0.95	+0.31	+0.02	+0.03	−0.04	−0.03	+0.20	−0.07	+0.99	−3.5	−1.1
29	Cape	δ Tauri	E	+0.91	−0.30	−0.13	−0.24	+0.27	+0.08	−0.20	+0.29	−0.95	+1.9	−0.3
Nov. 10	Radcliffe	30 Capricor.	I	−0.62	+0.36	+0.73	−0.16	+0.75	+0.15	+0.16	−0.58	−0.66	−3.6	−2.1
17	Madrid	μ Ceti	I	−0.88	+0.82	−0.04	−0.28	+0.28	+0.10	+0.33	+0.09	−0.24	+0.2	+2.3
17	Madrid	μ Ceti	EB	+0.74	−0.68	−0.09	−0.59	+0.60	+0.19	−0.23	+0.46	+0.20	−2.1	−3.7
Dec. 8	Göttingen	δ Capricor.	I	−0.76	+0.45	−0.55	+0.21	−0.59	−0.15	+0.18	+0.30	−0.70	−6.5	−4.7
14	Greenwich	ξ² Ceti	I	−0.67	+0.68	−0.07	−0.66	+0.66	+0.25	+0.30	+0.31	−0.54	−3.5	−1.9
14	Radcliffe	ξ² Ceti	EB	+0.91	−0.90	0.00	+0.02	−0.02	−0.02	−0.33	+0.09	+0.71	+7.6	+5.7
1870, Jan. 5	Washington	182 B. Aquarii	I	−0.72	+0.55	−0.53	+0.52	−0.64	−0.19	+0.20	+0.23	−0.53	−1.0	+0.7
Feb. 7	Washington	μ Ceti	I	−0.90	+0.90	−0.02	−0.08	+0.08	+0.05	+0.33	−0.04	−1.00	−1.5	+0.5
9	Leiden	63 Tauri	I	−0.93	+0.60	+0.05	+0.06	−0.08	−0.03	+0.22	−0.16	−0.93	−2.3	−0.3
10	Leiden	m Tauri	I	−0.56	+0.26	−0.61	−0.53	+0.81	+0.12	+0.11	+0.74	−0.51	+7.0	+8.2
10	Göttingen	m Tauri	I	−0.54	+0.25	−0.62	−0.54	+0.82	+0.13	+0.10	+0.84	−0.49	−1.4	−0.2
10	Greenwich	m Tauri	I	−0.51	+0.24	−0.63	−0.55	+0.84	+0.13	+0.10	+0.77	−0.46	−0.7	+0.4
11	Leiden	χ² Orionis	I	−0.31	+0.07	−0.84	−0.44	+0.95	+0.06	+0.03	+0.92	−0.22	−1.5	−0.8
11	Leiden	χ² Orionis	EB	+0.42	−0.07	−0.80	−0.42	+0.90	+0.08	−0.02	+0.93	+0.30	−4.9	−5.8
11	Radcliffe	χ² Orionis	I	−0.08	+0.02	−0.88	−0.47	+1.00	+0.07	+0.01	+0.99	−0.06	−0.6	−0.4
11	Radcliffe	χ² Orionis	EB	+0.19	−0.04	−0.86	−0.46	+0.98	+0.09	−0.01	+0.99	+0.14	−3.7	−4 1
12	Washington	ζ Geminor.	I	−0.30	−0.29	−0.92	−0.25	+0.95	−0.03	0.00	+0.89	−0.17	−0.9	−0.2
22	Cape	24 Scorpii	IB	−0.69	−0.48	−0.51	−0.56	−0.75	+0.06	−0.16	+0.65	+0.66	+0.1	+1.6
22	Cape	24 Scorpii	E	+0.42	+0.30	−0.62	−0.67	−0.92	+0.23	+0.04	+0.89	−0.41	+1.3	+0.5
Mar. 10	Cape	ζ Tauri	IB	−0.88	+0.32	−0.32	−0.21	+0.38	+0.02	+0.12	+0.34	−0.90	+1.3	+3.2
10	Washington	χ¹ Orionis	I	−0.37	+0.13	−0.81	−0.43	+0.92	+0.07	+0.04	+0.89	−0.38	−2.8	−2.0
10	Washington	χ¹ Orionis	EB	+0.57	−0.20	−0.71	−0.38	+0.81	+0.09	−0.05	+0.85	+0.57	−0.7	−1.8
23	Cape	15 Sagittarii	E	+0.72	+0.36	−0.64	−0.28	−0.70	+0.11	+0.04	+0.03	−0.70	+1.7	+0.3
June 16	Leipzig	η Capricor.	IB	−0.89	+0.04	+0.45	−0.17	+0.48	+0.01	+0.18	−0.43	+0.56	−8.2	−6.5
July 10	Leiden	158 G. Ophiuchi	I	−1.04	−0.66	−0.27	−0.13	−0.30	−0.12	−0.13	+0.20	−0.45	−0.7	+1.3
Aug. 9	Radcliffe	4 Capricor.	I	−0.61	−0.14	+0.78	−0.17	+0.80	+0.04	+0.08	−0.74	−0.23	−5.2	−4.0
17	Leiden	μ Ceti	IB	−0.82	+0.91	+0.16	+0.38	−0.41	−0.12	+0.29	−0.35	+0.88	−1.9	−0.3
17	Greenwich	μ Ceti	E	+0.85	−0.94	+0.13	+0.31	−0.34	−0.03	−0.34	−0.11	−0.90	+2.2	+0.8
19	Greenwich	64 Tauri	E	+0.73	−0.70	+0.44	+0.40	−0.60	−0.14	−0.20	−0.47	−0.78	+1.1	−0.1
Sept. 6	Washington	η Capricor.	I	−0.78	−0.08	+0.56	−0.26	+0.62	+0.06	+0.17	−0.48	−0.51	−3.5	−2.1
7	Cape	δ Capricor.	I	−0.96	+0.07	+0.16	−0.11	+0.20	−0.02	+0.26	−0.14	−0.52	−1.7	0.0
7	Cape	δ Capricor.	EB	+0.82	−0.06	+0.44	−0.32	+0.54	+0.18	−0.19	−0.35	+0.45	−0.8	−2.2
16	Greenwich	i Tauri	E	+0.91	−0.85	+0.01	+0.01	−0.01	−0.01	−0.20	+0.09	−0.98	+3.4	+1.9
28	Cape	γ Libræ	I	−0.67	−0.60	−0.50	−0.62	−0.80	+0.11	−0.22	+0.58	−0.41	+0.4	+1.6
28	Cape	γ Libræ	EB	+0.77	+0.68	−0.46	−0.56	−0.73	+0.35	+0.16	+0.65	+0.46	−3.5	−4.7
Oct. 1	Radcliffe	117 B. Sagittarii	I	−0.85	−0.57	+0.57	+0.08	+0.58	−0.08	+0.03	−0.58	−0.82	−3.2	−1.7
1	Greenwich	117 B. Sagittarii	I	−0.89	−0.59	+0.51	+0.07	+0.52	−0.13	−0.03	−0.58	−0.84	−3.9	−2.3
14	Greenwich	ζ Tauri	IB	−0.91	−0.75	+0.04	+0.01	−0.04	0.00	+0.13	−0.12	+0.90	−5.9	−4.3
14	Greenwich	ζ Tauri	E	+0.91	+0.75	+0.03	+0.01	−0.03	−0.01	−0.13	+0.04	−0.90	+7.2	+5.8
Nov. 9	Radcliffe	68 Tauri	IB	−0.64	−0.27	−0.56	−0.42	+0.70	+0.18	+0.19	+0.57	+0.26	−5.5	−4.4
9	Radcliffe	68 Tauri	E	+0.46	+0.19	−0.53	−0.68	+0.86	+0.18	−0.10	+0.82	−0.18	−7.0	−7.7
Dec. 27	Cape	ψ¹ Aquarii	I	−0.92	+0.21	−0.14	+0.29	−0.32	−0.16	+0.31	0.00	−0.84	−0.7	+0.8

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1870, Dec. 27	Cape	ψ^2 Aquarii	I	−0.35	+0.08	+0.39	−0.85	+0.93	+0.31	+0.19	+0.27	−0.32	−0.9	−0.3
1871, Jan. 11	Leiden	ν Virginis	IB	−1.01	−0.50	+0.04	−0.11	−0.12	−0.05	−0.38	−0.10	+0.90	−3.2	−1.6
11	Leiden	ν Virginis	E	+1.02	+0.50	+0.03	−0.09	−0.10	+0.14	+0.34	+0.07	−0.90	+0.9	−0.5
Feb. 1	Cape	1 Geminor.	I	−0.92	+0.82	+0.12	+0.02	−0.12	−0.01	+0.10	−1.00	−0.63	−0.5	+1.0
1	Cape	1 Geminor.	EB	+0.92	−0.83	0.00	0.00	0.00	+0.01	−0.09	+1.00	+0.64	−1.1	−2.3
28	Washington	141 Tauri	I	−0.85	+0.80	+0.37	+0.05	−0.37	−0.03	+0.07	−0.44	−0.86	+1.0	+2.3
Mar. 3	Greenwich	η Cancri	I	−0.86	+0.32	−0.43	+0.22	+0.48	−0.12	−0.17	+0.33	−0.46	+0.3	+1.6
3	Greenwich	39 Cancri	I	−0.97	+0.36	−0.11	+0.06	+0.13	−0.09	−0.16	+0.04	−0.51	−1.7	−0.3
May 5	Cape	θ Libræ	E	+1.04	+0.88	−0.36	−0.25	−0.44	+0.35	+0.23	+0.43	−0.22	+1.1	−0.1
June 29	Cape	θ Libræ	I	−1.06	−0.93	−0.27	−0.18	−0.33	−0.11	−0.30	+0.22	−0.55	−0.8	+0.5
29	Washington	ν Scorpii	I	−0.98	−0.85	+0.44	+0.24	+0.50	−0.31	−0.22	−0.52	−0.50	−2.3	−1.1
Sept. 7	Washington	3 Geminor.	E	+0.87	−0.96	−0.26	+0.02	+0.26	+0.01	−0.08	+0.34	−0.93	+0.4	−0.5
22	Washington	χ Sagittarii	I	−0.81	−0.72	−0.60	+0.24	−0.65	−0.15	+0.06	+0.59	−0.75	−0.8	+0.1
27	Washington	33 Piscium	EB	+0.94	+0.07	−0.01	−0.36	+0.35	+0.22	−0.34	+0.07	+0.25	−2.2	−3.0
Oct. 3	Washington	ι Tauri	IB	−0.90	+0.98	−0.06	+0.01	+0.07	+0.02	+0.21	−0.06	+0.87	−2.7	−1.7
3	Washington	ι Tauri	E	+0.84	−0.91	−0.36	+0.06	+0.36	+0.06	−0.19	+0.45	−0.81	+1.0	+0.2
21	Washington	χ Capricor.	I	−1.03	−0.75	−0.14	+0.15	−0.20	−0.18	+0.21	+0.08	−0.97	+0.9	+1.9
23	Greenwich	69 Aquarii	I	−0.55	−0.24	+0.80	−0.26	+0.84	+0.23	+0.24	−0.38	−0.48	−0.2	+0.3
23	Greenwich	τ Aquarii	I	−1.01	−0.44	+0.07	−0.02	+0.07	−0.08	+0.36	−0.12	−0.87	−0.3	+0.7
23	Leiden	69 Aquarii	I	−0.35	−0.15	+0.29	−0.90	+0.94	+0.27	+0.17	−0.40	−0.29	+1.2	+1.6
23	Leiden	69 Aquarii	EB	+0.15	+0.06	+0.30	−0.94	+0.99	+0.35	+0.01	−0.36	+0.12	+2.7	+2.6
23	Leiden	τ Aquarii	I	−1.01	−0.44	+0.04	−1.14	+0.15	−0.06	+0.37	−0.16	−0.86	+0.5	+1.5
23	Leiden	τ Aquarii	EB	+0.92	+0.40	+0.12	−0.40	+0.42	+0.24	−0.30	−0.08	+0.79	−5.4	−6.2
23	Radcliffe	69 Aquarii	I	−0.61	−0.26	+0.21	−0.78	+0.80	+0.20	+0.26	−0.37	−0.52	−4.3	−3.7
23	Radcliffe	τ Aquarii	I	−1.02	−0.44	+0.01	−0.04	+0.04	−0.10	+0.36	−0.11	−0.87	−0.4	+0.6
23	Radcliffe	τ Aquarii	EB	+0.96	+0.42	+0.08	−0.31	+0.32	+0.21	−0.32	−0.03	−0.83	−3.6	−4.4
27	Washington	64 Ceti	I	−0.54	+0.27	+0.50	+0.66	−0.83	−0.35	+0.15	−0.49	−0.09	−1.5	−1.0
Nov. 15	Radcliffe	λ Sagittarii	I	−1.12	−1.00	+0.08	−0.02	+0.08	−0.22	−0.05	−0.17	−0.65	−0.2	+0.9
18	Radcliffe	ϵ Capricor.	I	−0.50	−0.36	−0.48	+0.74	−0.88	−0.29	+0.09	+0.53	−0.47	+0.2	+0.7
18	Leipzig	ϵ Capricor.	I	−0.81	−0.58	−0.35	+0.52	−0.63	−0.27	+0.19	+0.35	−0.76	+0.2	+1.0
18	Altona	ϵ Capricor.	I	−0.71	−0.50	−0.41	+0.61	−0.74	−0.28	+0.16	+0.44	−0.66	−0.1	0.6
27	Radcliffe	ι Tauri	IB	−0.90	+0.94	−0.17	−0.02	+0.17	+0.03	+0.21	+0.06	+0.40	−6.2	−5.3
Dec. 1	Radcliffe	γ Cancri	IB	−0.90	−0.77	+0.08	−0.08	−0.11	+0.02	−0.19	−0.17	−0.81	+1.5	+2.4
1	Radcliffe	γ Cancri	E	+0.85	−0.73	+0.27	−0.27	−0.38	+0.08	+0.17	−0.23	+0.45	−3.4	−4.0
18	Washington	24 B. Ceti	I	−0.96	−0.20	−0.03	−0.26	+0.27	+0.03	+0.44	−0.17	−0.97	−3.0	−2.1
20	Greenwich	ν Piscium	I	−0.51	+0.14	+0.45	+0.71	−0.84	−0.37	+0.15	−0.39	−0.51	−1.7	−1.2
20	Radcliffe	ν Piscium	I	−0.49	+0.14	+0.49	+0.71	−0.86	−0.37	+0.13	−0.39	−0.51	−1.5	−1.0
1872, Jan. 23	Radcliffe	ω Geminor.	I	−0.43	+0.47	+0.80	−0.36	−0.88	0.00	0.00	−0.90	−0.13	−1.2	−0.8
Feb. 21	Washington	γ Cancri	I	−0.33	+0.32	−0.64	+0.67	+0.93	−0.17	−0.06	+0.74	−0.15	−2.7	−2.4
21	Washington	γ Cancri	EB	+0.21	+0.21	−0.66	+0.70	+0.97	−0.17	+0.06	+0.81	+0.10	−8.5	−8.6
21	Greenwich	γ Cancri	I	−0.86	+0.84	+0.22	−0.24	−0.33	+0.06	−0.19	−0.33	−0.39	−0.9	−0.2
21	Greenwich	γ Cancri	EB	+0.74	−0.73	+0.38	−0.44	−0.58	+0.11	+0.15	−0.47	+0.34	+0.8	+0.4
Apr. 25	Washington	22 Ophiuchi	E	+1.09	+0.83	−0.15	0.00	−0.15	+0.23	+0.20	+0.21	−0.65	+0.7	+0.1
May 19	Leiden	65 Virginis	I	−0.98	−0.07	−0.18	−0.25	−0.31	+0.01	−0.43	+0.03	−0.51	−1.0	−0.4
19	Leiden	66 Virginis	I	−1.01	−0.07	−0.11	−0.14	−0.18	−0.04	−0.43	+0.01	−0.53	−0.5	+0.1
19	Greenwich	65 Virginis	I	−1.01	−0.07	−0.10	−0.15	−0.18	−0.05	−0.44	−0.02	−0.53	−0.8	−0.2
19	Greenwich	66 Virginis	I	−1.03	−0.07	+0.03	−0.05	−0.06	−0.10	−0.42	−0.05	−0.54	−2.4	−1.8
22	Leiden	ω^1 Scorpii	IB	−1.09	−0.67	−0.17	−0.04	−0.17	−0.16	−0.29	+0.08	+0.07	−6.0	−5.3
22	Leiden	ω^2 Scorpii	IB	−1.06	−0.65	+0.28	+0.06	+0.29	−0.27	−0.25	−0.32	+0.07	−3.7	−3.1
22	Greenwich	ω^2 Scorpii	E	+1.11	+0.67	+0.13	+0.02	+0.13	+0.18	+0.29	−0.04	−0.07	−2.7	−3.2
22	Radcliffe	ω^2 Scorpii	E	+1.10	+0.67	+0.15	+0.03	+0.15	+0.17	+0.29	−0.05	−0.07	−2.4	−2.9
July 22	Greenwich	69 Aquarii	E	+1.11	+0.83	0.00	−0.08	+0.08	+0.25	−0.37	+0.05	−0.51	−1.4	−1.8
Aug. 12	Radcliffe	λ Libræ	I	−1.02	−0.59	−0.19	−0.03	−0.19	−0.07	−0.21	+0.17	−0.95	−0.4	+0.2
15	Vienna	σ Sagittarii	I	−0.99	−0.84	−0.41	+0.26	−0.49	−0.20	0.00	+0.54	−0.57	−0.6	−0.1
15	Neuchatel	σ Sagittarii	I	−1.00	−0.85	−0.38	+0.24	−0.45	−0.20	0.00	+0.46	−0.58	+2.0	+2.5
15	Leipzig	σ Sagittarii	I	−0.95	−0.81	−0.45	+0.28	−0.53	−0.19	0.00	+0.43	−0.55	−0.5	0.0
15	Leipzig	σ Sagittarii	EB	+0.98	+0.83	−0.42	+0.26	−0.50	+0.18	−0.02	+0.56	+0.56	−7.6	−8.0
15	Greenwich	σ Sagittarii	EB	+0.96	+0.82	−0.45	+0.28	−0.53	+0.19	−0.01	+0.58	+0.55	−0.4	−0.8
Sept. 15	Greenwich	69 Aquarii	I	−1.08	−0.84	+0.04	−0.26	+0.26	+0.12	+0.38	−0.17	−0.36	−0.7	−0.2
15	Greenwich	τ Aquarii	I	−1.05	−0.82	0.00	+0.35	−0.35	−0.32	+0.32	+0.06	−0.35	−1.2	−0.7
15	Radcliffe	69 Aquarii	I	−1.09	−0.84	+0.23	+0.03	+0.23	−0.13	+0.38	−0.18	−0.36	+4.3	+4.8
15	Radcliffe	τ Aquarii	I	−1.03	−0.80	−0.38	−0.05	−0.38	−0.34	+0.32	+0.07	−0.34	+4.9	+5.4
15	Radcliffe	τ Aquarii	EB	+1.12	+0.87	−0.10	−0.01	−0.10	+0.19	−0.39	+0.12	+0.37	−7.2	−7.6
21	Washington	ω Tauri	IB	−0.78	−0.22	−0.58	+0.04	+0.58	+0.08	+0.25	+0.47	+0.67	−3.7	−3.3
21	Washington	ω Tauri	E	+0.51	−0.20	−0.85	−0.04	+0.85	+0.25	−0.11	+0.80	−0.44	−2.8	−3.0
21	Washington	53 Tauri	IB	−0.81	+0.31	+0.54	+0.02	−0.54	−0.19	+0.21	−0.56	+0.71	−2.1	−1.7
24	Greenwich	ϵ Geminor.	IB	−0.90	+0.85	−0.13	+0.08	+0.15	−0.01	+0.02	+0.06	+0.99	−1.8	−1.4
24	Greenwich	ϵ Geminor.	E	+0.83	−0.79	−0.38	+0.21	+0.40	+0.01	0.00	+0.47	−0.92	+3.1	+2.8
24	Washington	37 Geminor.	E	+0.89	−0.84	+0.17	−0.12	−0.20	+0.01	0.00	−0.13	−0.65	+3.1	+2.8
Oct. 11	Radcliffe	35 Capricor.	I	−0.60	−0.54	+0.26	−0.80	−0.84	+0.11	+0.19	−0.38	−0.50	−5.5	−5.2

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1872, Oct. 11	Greenwich	35 Capricor.	I	−0.51	−0.47	+0.29	−0.83	+0.88	+0.15	+0.16	−0.65	−0.43	−1.9	−1.6
14	Greenwich	33 Piscium	I	−1.05	−0.69	−0.09	−0.24	+0.26	−0.08	+0.43	−0.11	−0.50	−0.8	−0.3
15	Washington	33 Ceti	I	−1.06	−0.45	+0.10	−0.10	−0.14	−0.23	+0.42	−0.13	−0.25	0.0	+0.5
15	Washington	f Piscium	I	−1.03	−0.43	−0.18	+0.21	+0.27	−0.04	+0.45	+0.13	−0.24	−1.9	−1.4
Dec. 9	Greenwich	f Piscium	I	−0.60	−0.32	+0.58	+0.58	−0.81	−0.42	+0.17	−0.21	−0.54	−0.3	−0.1
9	Radcliffe	f Piscium	E	+0.82	+0.43	+0.44	+0.41	−0.60	−0.16	−0.41	−0.11	+0.74	−6.3	−6.4
1873, Jan. 22	Radcliffe	28 Libræ	IB	−0.83	−0.09	−0.55	−0.09	−0.56	+0.10	−0.33	+0.37	+0.76	−2.6	−2.4
Mar. 1	Washington	μ Piscium	I	−1.02	−0.55	+0.29	+0.21	−0.36	−0.34	+0.37	−0.20	−0.54	+1.6	+1.9
5	Washington	103 Tauri	I	−0.94	+0.29	−0.13	+0.04	+0.14	−0.03	+0.18	+0.06	−0.99	−1.6	−1.3
Apr. 2	Strassburg	118 Tauri (S)	I	−0.94	+0.27	+0.22	−0.10	−0.25	−0.10	+0.14	−0.31	−0.85	−4.6	−4.3
2	Strassburg	118 Tauri (N)	I	−0.94	+0.27	+0.22	−0.11	−0.25	−0.10	+0.15	−0.31	−0.85	−1.1	−0.8
2	Vienna	118 Tauri	I	−0.89	+0.31	+0.36	−0.17	−0.39	−0.12	+0.13	−0.46	−0.81	+0.1	+0.4
2	Radcliffe	118 Tauri (S)	I	−0.94	+0.35	+0.22	−0.10	−0.24	−0.10	+0.14	−0.31	−0.85	−7.1	−6.8
2	Radcliffe	118 Tauri (N)	I	−0.94	+0.35	+0.22	−0.10	−0.24	−0.10	+0.14	−0.31	−0.85	−8.7	−8.4
30	Nikolaieff	139 Tauri	I	−0.90	+0.38	+0.32	−0.21	−0.39	−0.12	+0.08	−0.45	−0.64	−0.6	−0.3
May 1	Greenwich	39 Geminor.	I	−0.93	+0.59	−0.10	+0.11	+0.15	−0.06	−0.03	+0.07	−0.82	−2.3	−2.0
1	Nikolaieff	39 Geminor.	I	−0.90	+0.57	+0.22	−0.23	−0.30	−0.04	−0.02	−0.38	−0.79	−0.4	−0.1
1	Nikolaieff	40 Geminor.	I	−0.92	+0.58	−0.16	+0.22	+0.24	−0.05	−0.02	+0.15	−0.80	−0.7	−0.4
5	Nikolaieff	42 Leonis	I	−0.79	+0.88	+0.04	+0.47	+0.47	−0.17	−0.30	+0.20	−0.84	−0.6	−0.4
11	Nikolaieff	8 Libræ	I	−0.92	+0.24	+0.36	+0.08	+0.37	−0.22	−0.24	−0.32	−0.06	+0.6	+0.8
11	Nikolaieff	α Libræ	I	−0.90	+0.23	+0.41	+0.09	+0.41	−0.24	−0.32	−0.34	−0.05	0.0	+0.2
11	Nikolaieff	α Libræ	EB	+0.98	−0.26	+0.08	+0.02	+0.08	+0.06	+0.40	+0.01	+0.05	0.0	0.0
16	Nikolaieff	ω Sagittarii	E	+0.98	+0.75	−0.20	+0.35	−0.40	+0.12	−0.13	+0.44	−0.81	−1.3	−1.3
June 5	Nikolaieff	46 Virginis	I	−0.67	+0.51	−0.53	−0.44	−0.69	+0.29	−0.41	+0.12	−0.59	−0.5	−0.5
July 1	Nikolaieff	b Virginis	I	−0.73	+0.74	+0.34	+0.48	+0.59	−0.26	−0.29	−0.01	−0.80	−1.0	−0.8
2	Nikolaieff	γ Virginis	EB	+0.91	−0.81	+0.04	+0.04	+0.06	−0.01	+0.44	+0.04	+1.00	+3.1	+3.0
4	Greenwich	λ Virginis	I	−0.71	+0.29	+0.65	+0.19	+0.68	−0.32	−0.18	−0.42	−0.60	+1.7	+1.9
4	Radcliffe	λ Virginis	I	−0.69	+0.32	+0.65	+0.20	+0.68	−0.31	−0.24	−0.44	−0.65	+1.3	+1.5
19	Nikolaieff	κ Tauri	E	+0.82	+0.14	+0.53	−0.15	−0.55	−0.06	−0.24	−0.43	−0.71	−0.5	−0.4
19	Nikolaieff	67 Tauri	E	+0.97	+0.16	+0.18	−0.05	−0.18	+0.04	−0.26	−0.10	−0.10	+0.1	+0.2
Aug. 6	Washington	ω Sagittarii	I	−1.12	−0.74	−0.01	+0.04	−0.03	−0.23	+0.13	−0.04	−0.31	−0.6	−0.4
6	Washington	A Sagittarii	I	−1.12	−0.74	+0.02	−0.04	+0.04	−0.22	+0.15	−0.10	−0.31	−0.7	−0.5
9	Greenwich	τ Aquarii	IB	−1.04	−0.90	+0.13	+0.42	−0.44	−0.41	+0.32	+0.11	+0.27	−2.2	−2.0
9	Nikolaieff	τ Aquarii	IB	−1.15	−1.00	0.00	−0.01	+0.01	−0.26	+0.41	−0.08	+0.32	−1.6	−1.4
9	Nikolaieff	τ Aquarii	E	+0.48	+0.42	+0.28	+0.86	−0.91	−0.24	−0.24	+0.39	−0.13	−1.5	−1.5
10	Nikolaieff	376 B. Aquarii	E	+1.10	+0.94	+0.15	+0.22	−0.27	+0.12	−0.47	+0.11	−0.51	+1.8	+1.9
11	Nikolaieff	15 Ceti	E	+1.12	+0.93	−0.03	−0.03	+0.04	+0.24	−0.44	−0.07	−0.79	−0.6	−0.5
12	Nikolaieff	μ Piscium	E	+0.98	+0.75	+0.38	+0.20	−0.43	−0.02	−0.44	−0.08	−0.75	+1.0	+1.1
18	Nikolaieff	39 Geminor.	E	+0.92	−0.41	−0.10	+0.12	+0.16	+0.04	+0.22	+0.22	−0.77	−1.0	−0.9
Oct. 3	Greenwich	τ Aquarii	I	−1.01	−0.87	+0.16	+0.44	−0.47	−0.41	+0.31	+0.12	−0.51	+0.2	+0.4
3	Nikolaieff	τ Aquarii	I	−1.10	−0.96	−0.09	−0.24	+0.25	−0.14	+0.42	−0.18	−0.56	−0.6	−0.4
3	Radcliffe	69 Aquarii	I	−1.10	−0.96	−0.10	−0.24	+0.26	−0.14	+0.41	−0.18	−0.56	0.0	+0.2
9	Nikolaieff	υ Tauri	E	+0.27	+0.09	−0.91	+0.33	+0.97	+0.27	−0.03	+0.90	−0.17	+1.9	+1.9
9	Nikolaieff	72 Tauri	E	+0.70	+0.22	−0.70	+0.26	+0.74	+0.29	−0.15	+0.73	−0.43	+0.9	+1.0
13	Greenwich	λ Cancri	E	+0.64	−0.41	−0.20	+0.69	+0.72	−0.10	+0.15	+0.66	+0.69	+1.0	+1.1
Dec. 1	Greenwich	o Arietis	I	−0.97	−0.62	+0.45	+0.01	−0.45	−0.35	+0.31	−0.27	−0.46	−1.4	−1.2
24	Greenwich	τ Aquarii	I	−0.95	−0.84	−0.20	−0.43	+0.47	+0.02	+0.40	−0.24	−0.79	+0.1	+0.3
24	Greenwich	τ Aquarii	EB	+0.76	+0.66	−0.30	−0.64	+0.71	+0.42	−0.23	−0.24	+0.63	−1.3	−1.1
24	Radcliffe	τ Aquarii	I	−0.99	−0.86	−0.16	−0.39	+0.42	−0.02	+0.40	−0.24	−0.82	−0.3	−0.1

GROUP XII—1874–1890.

1874, Jan. 25	Greenwich	53 Arietis	I	−0.89	−0.63	+0.50	−0.07	−0.51	−0.31	+0.28	−0.45	−0.85	−0.8	−0.6
25	Radcliffe	53 Arietis	I	−0.88	−0.62	+0.51	−0.06	−0.52	−0.30	+0.27	−0.43	−0.84	+0.2	+0.4
26	Radcliffe	A Tauri	I	−0.97	−0.51	−0.31	+0.11	+0.33	−0.05	+0.28	+0.22	−0.88	−1.6	−1.4
27	Radcliffe	k Tauri	I	−1.00	−0.36	−0.07	+0.04	+0.08	−0.10	+0.19	+0.03	−0.84	−2.4	−2.2
27	Greenwich	k Tauri	I	−1.00	−0.36	−0.08	+0.06	+0.10	−0.10	+0.19	+0.01	−0.86	−1.6	−1.4
30	Greenwich	c Geminor.	I	−0.65	+0.16	+0.25	−0.70	−0.74	+0.03	−0.09	−0.72	−0.27	−1.0	−0.9
30	Radcliffe	c Geminor.	I	−0.61	+0.15	+0.24	−0.73	−0.77	+0.05	−0.09	−0.75	−0.26	+0.2	+0.3
Mar. 26	Radcliffe	λ Cancri	I	−0.55	+0.17	−0.10	+0.80	+0.81	−0.18	−0.10	+0.67	−0.55	−0.1	0.0
26	Greenwich	λ Cancri	I	−0.57	+0.18	−0.10	+0.78	+0.79	−0.19	−0.11	+0.67	−0.57	+0.1	+0.2
31	Greenwich	10 Virginis	I	−0.88	+0.97	−0.15	−0.12	−0.19	+0.08	−0.47	−0.05	−0.20	−0.6	−0.4
Apr. 22	Radcliffe	ω Cancri	I	−0.81	+0.15	+0.09	−0.54	−0.55	+0.01	−0.16	−0.53	−0.81	−2.3	−2.1
22	Radcliffe	4 Cancri	I	−0.89	+0.17	−0.06	+0.35	+0.36	−0.12	−0.16	+0.28	−0.90	−4.4	−4.2
May 19	Greenwich	c Geminor.	I	−0.74	+0.04	+0.15	−0.66	−0.68	−0.01	−0.12	−0.66	−0.54	+1.9	+2.0
July 8	Greenwich	53 Arietis	E	+1.00	+0.83	−0.35	+0.10	+0.36	+0.30	−0.31	+0.34	−0.81	−2.0	−1.8
Aug. 20	Washington	α Scorpii	I	−0.87	+0.63	+0.28	−0.20	+0.34	−0.09	−0.23	−0.36	−0.91	+1.7	+1.9

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1874, Aug. 31	Strassburg	29 Arietis	E	+0.92	+0.84	−0.54	+0.09	+0.55	+0.49	−0.29	+0.39	−0.71	−4.5	−4.3
Oct. 22	Greenwich	27 Piscium	I	−1.06	−0.84	+0.30	+0.17	−0.35	−0.40	+0.40	−0.01	−0.46	−0.5	−0.3
22	Greenwich	29 Piscium	I	−1.07	−0.85	+0.28	+0.15	−0.32	−0.40	+0.40	−0.03	−0.47	+0.8	+1.0
25	Strassburg	π Arietis	IB	−1.16	−0.98	−0.06	+0.02	+0.06	−0.26	+0.40	0.00	+0.14	−2.0	−1.8
25	Strassburg	π Arietis	E	+1.14	+0.97	−0.14	+0.04	+0.14	+0.30	−0.38	+0.13	−0.14	−3.6	−3.4
Nov. 19	Greenwich	10 Ceti	I	−0.75	−0.62	−0.70	−0.25	+0.74	+0.19	+0.40	+0.01	−0.50	−2.0	−1.8
Dec. 16	Radcliffe	29 Piscium	I	−0.89	−0.72	+0.49	+0.23	−0.54	−0.40	+0.33	−0.01	−0.82	−1.5	−1.3
19	Radcliffe	π Arietis	I	−1.06	−0.94	−0.28	+0.10	+0.30	−0.11	+0.39	+0.31	−0.65	+0.2	+0.4
19	Greenwich	π Arietis	I	−1.05	−0.94	−0.31	+0.11	+0.33	−0.10	+0.39	+0.18	−0.65	+4.4	+4.6
19	Washington	45 Arietis	I	−0.97	−0.86	+0.46	+0.18	−0.50	−0.37	+0.29	−0.39	−0.59	−0.2	0.0
1875, Jan. 16	Radcliffe	63 Arietis	I	−1.06	−0.94	+0.17	−0.09	−0.19	−0.26	+0.32	−0.19	−0.86	−0.6	−0.4
20	Radcliffe	c Geminor.	I	−0.88	−0.32	0.00	+0.55	+0.55	−0.22	−0.13	+0.49	−0.19	−0.6	−0.4
30	Leipzig	31 B. Scorpii	IB	−0.75	+0.79	+0.44	−0.35	+0.56	−0.17	−0.22	−0.50	+0.78	−8.4	−8.2
Feb. 13	Leipzig	36 Tauri	I	−0.90	−0.79	+0.41	−0.36	−0.55	−0.30	+0.22	−0.49	−0.83	+1.2	+1.4
Mar. 16	Leipzig	ω Cancri	I	−1.01	−0.42	0.00	−0.02	−0.02	−0.13	−0.21	−0.04	−0.90	−0.7	−0.5
16	Leipzig	4 Cancri	I	−0.63	−0.26	+0.10	+0.78	+0.79	−0.23	−0.11	+0.71	−0:56	+0.6	+0.7
May 12	Greenwich	37 Leonis	I	−0.47	0.00	+0.60	+0.63	+0.87	−0.39	−0.12	+0.46	−0.49	−2.1	−2.0
12	Radcliffe	37 Leonis	I	−0.45	0.00	+0.61	+0.63	+0.87	−0.40	−0.13	+0.44	−0.49	−1.3	−1.2
Aug 10	Cape	σ Scorpii	I	−0.74	+0.82	−0.32	+0.47	−0.57	+0.09	−0.21	+0.51	−0.78	−0.7	−0.5
13	Washington	234 B. Sagittarii	I	−0.94	+0.67	+0.01	+0.05	−0.05	−0.07	+0.14	+0.02	−0.54	−2.2	−1.9
Sept. 10	Washington	A Sagittarii	I	−0.83	+0.52	+0.14	+0.48	−0.49	−0.16	+0.17	+0.45	−0.67	0.0	+0.3
12	Vienna	33 Capricor.	I	−0.71	+0.21	−0.40	−0.55	+0.69	+0.15	+0.29	+0.40	−0.39	−2.5	−2.3
14	Washington	χ Aquarii	I	−0.92	−0.19	+0.44	+0.20	−0.49	−0.38	+0.35	+0.11	−0.07	+2.6	+2.9
14	Washington	χ Aquarii	EB	+0.94	+0.20	+0.41	+0.18	−0.45	−0.05	−0.47	+0.16	+0.07	−4.1	−4.0
Oct. 3	Washington	A Scorpii	I	−0.90	−0.77	−0.07	+0.09	−0.11	0.00	−0.28	+0.08	−0.73	−0.5	−0.2
3	Washington	3 Scorpii	I	−0.72	−0.62	−0.37	+0.47	−0.61	+0.13	−0.22	+0.53	−0.59	−1.4	−1.2
16	Greenwich	ζ Arietis	IB	−0.94	−0.78	+0.41	−0.37	−0.55	−0.38	+0.25	−0.45	+0.35	−7.4	−7.1
16	Greenwich	ζ Arietis	E	+1.08	+0.90	+0.21	−0.20	−0.29	+0.15	−0.31	−0.17	−0.40	+0.2	+0.3
20	Washington	ω Cancri	E	+0.98	+0.73	+0.10	+0.34	+0.35	+0.09	+0.22	+0.33	−0.91	−4.5	−4.4
24	Radcliffe	σ Leonis	E	+0.62	+0.04	−0.73	−0.25	−0.77	+0.42	+0.21	−0.17	−0.50	−5.1	−5.0
Nov. 8	Radcliffe	χ Aquarii	I	−0.60	−0.13	−0.77	−0.27	+0.81	+0.29	+0.37	−0.22	−0.50	−4.1	−3.9
16	Leipzig	47 Geminor.	IB	−0.95	−0.79	+0.07	+0.52	+0.53	−0.25	−0.09	+0.51	+0.75	−4.6	−4.3
16	Washington	c Geminor.	IB	−0.70	−0.59	+0.21	+0.75	+0.77	−0.26	−0.10	+0.71	+0.40	+1.4	+1.6
21	Greenwich	β Virginis	IB	−0.96	+0.05	−0.03	−0.01	−0.03	−0.07	−0.48	−0.01	+0.95	−0.2	+0.1
21	Greenwich	β Virginis	E	+0.95	−0.05	−0.14	−0.03	−0.14	+0.15	+0.45	−0.01	−0.94	−0.6	−0.5
Dec. 7	Vienna	44 Piscium	I	−0.92	−0.40	−0.46	0.00	−0.46	−0.36	+0.36	−0.05	−0.79	+0.8	+1.1
9	Vienna	19 Arietis	I	−1.10	−0.80	−0.07	+0.04	−0.08	−0.19	+0.43	+0.03	−0.64	−0.8	−0.5
9	Strassburg	19 Arietis	I	−1.10	−0.79	+0.13	−0.08	−0.15	−0.29	+0.39	−0.11	−0.63	+0.4	+0.7
1876, Jan. 1	Washington	70 Aquarii	EB	+0.87	+0.04	−0.39	−0.18	+0.43	+0.26	−0.35	+0.16	+0.81	−7.8	−7.7
7	Strassburg	Anon. 19	I	−1.05	+0.92	+0.19	−0.27	−0.33	−0.31	+0.26	−0.29	−0.65	+0.3	+0.6
7	Strassburg	Anon. 25	I	−1.02	+0.88	−0.24	+0.34	+0.41	−0.12	+0.27	+0.35	−0.62	+5.2	+5.5
7	Strassburg	Anon. 22	I	−0.84	+0.74	+0.38	−0.54	−0.66	−0.34	+0.18	−0.55	−0.52	−0.1	+0.2
7	Strassburg	Anon. 13	I	−0.29	+0.25	+0.55	−0.79	−0.96	−0.31	+0.03	−0.82	−0.17	−0.7	−0.6
7	Strassburg	26 Tauri	I	−1.12	+0.96	−0.01	+0.01	+0.01	−0.24	+0.28	+0.02	−0.67	−1.8	−1.5
7	Strassburg	Anon. 30	I	−1.12	+0.97	0.00	0.00	0.00	−0.25	+0.28	−0.01	−0.68	+4.0	+4.3
7	Strassburg	27 Tauri	I	−0.93	+0.81	+0.32	−0.46	−0.56	−0.35	+0.21	−0.47	−0.57	0.0	+0.3
7	Strassburg	28 Tauri	I	−0.67	+0.58	+0.45	−0.66	−0.80	−0.34	+0.13	−0.66	−0.41	−0.9	−0.7
7	Strassburg	Anon. 40	I	−1.08	+0.94	−0.14	+0.21	+0.26	−0.17	+0.28	+0.22	−0.66	+2.0	+2.3
7	Strassburg	27 Tauri	EB	+1.04	−0.90	+0.20	−0.30	−0.37	+0.14	−0.27	+0.15	+0.63	+0.6	+0.7
10	Strassburg	47 Geminor.	I	−1.11	−0.83	+0.04	+0.23	+0.24	−0.29	−0.12	+0.24	−0.02	−0.8	−0.5
10	Washington	c Geminor.	I	−0.95	−0.71	−0.18	−0.53	−0.55	−0.11	−0.18	−0.52	−0.02	+2.1	+2.4
Feb. 2	Greenwich	27 Arietis	I	−0.94	−0.72	−0.35	+0.27	+0.44	+0.01	+0.39	+0.27	−0.90	+0.4	+0.7
2	Leipzig	27 Arietis	I	−0.82	−0.63	−0.48	+0.38	+0.62	+0.10	+0.36	+0.39	−0.79	−1.4	−1.1
2	Nr. Leipzig	27 Arietis	I	−0.82	−0.63	−0.48	+0.38	+0.62	+0.10	+0.36	+0.38	−0.79	−2.0	−1.7
2	Radcliffe	27 Arietis	I	−0.96	−0.74	−0.32	+0.24	+0.40	−0.01	+0.39	+0.25	−0.92	+0.1	+0.4
2	Radcliffe	27 Arietis	EB	+0.87	+0.66	−0.45	+0.33	+0.56	+0.35	−0.29	+0.37	+0.83	−5.0	−4.9
16	Washington	A Scorpii	E	+0.73	−0.72	−0.31	+0.50	−0.60	+0.17	+0.17	+0.52	−0.80	−2.1	−2.0
Mar. 4	Washington	49 Aurigæ	I	−0.52	−0.48	+0.09	+0.87	+0.87	−0.13	−0.02	+0.87	−0.45	−2.0	−1.8
4	Washington	49 Aurigæ	EB	+0.52	+0.48	+0.09	+0.87	+0.88	+0.05	+0.03	+0.87	+0.45	−1.9	−1.9
5	Cape	ι Geminor.	I	−0.95	−0.80	+0.14	+0.46	+0.48	−0.26	−0.13	−0.12	−0.72	−2.6	−2.3
5	Washington	c Geminor.	I	−0.65	−0.55	+0.29	+0.74	+0.80	−0.26	−0.10	+0.73	−0.49	−1.0	−0.8
5	Washington	c Geminor.	EB	+0.88	+0.74	+0.22	+0.55	+0.59	+0.07	+0.18	+0.54	+0.66	−1.1	−1.1
6	Nr. Leipzig	γ Cancri	I	−0.80	−0.57	+0.39	+0.55	+0.67	−0.34	−0.19	+0.57	−0.47	+2.7	+2.9
Apr. 1	Leipzig	47 Geminor.	I	−0.63	−0.57	+0.22	+0.78	+0.81	−0.24	−0.07	+0.78	−0.59	+0.4	+0.6
1	Vienna	47 Geminor.	I	−0.54	−0.49	+0.24	+0.84	+0.86	−0.21	−0.06	+0.84	−0.50	−1.2	−1.0
1	Radcliffe	47 Geminor.	I	−0.26	−0.22	+0.28	+0.93	+0.97	−0.16	−0.02	+0.94	−0.23	−1.0	−0.9
4	Strassburg	34 Leonis	I	−1.01	−0.58	−0.20	−0.11	−0.23	−0.06	−0.44	−0.12	−0.76	−0.2	+0.2
7	Greenwich	f Virginis	I	−0.93	+0.08	+0.34	−0.06	+0.35	−0.27	−0.40	−0.04	−0.22	−1.7	−1.3
7	Strassburg	f Virginis	I	−0.97	+0.09	+0.22	−0.04	+0.22	−0.21	−0.43	+0.66	−0.22	−0.3	+0.1
11	Greenwich	b Scorpii	E	+0.56	−0.52	+0.38	−0.70	+0.80	−0.16	+0.20	−0.68	−0.36	+0.3	+0.3

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1876, May 4	Washington	f Virginis	I	−0.88	+0.04	−0.43	+0.09	−0.44	+0.11	−0.48	+0.08	−0.58	−0.5	−0.1
5	Greenwich	50 Virginis	I	−0.90	+0.20	+0.34	−0.13	+0.37	−0.25	−0.38	−0.11	−0.48	−1.0	−0.6
June 1	Washington	50 Virginis	I	−0.92	+0.12	−0.26	+0.11	−0.27	+0.05	−0.47	+0.10	−0.83	−0.5	−0.1
5	Strassburg	65 B. Scorpii	I	−0.77	+0.65	−0.20	+0.49	−0.53	+0.09	−0.20	+0.49	−0.17	−0.7	−0.4
29	Leipzig	i Virginis	I	−0.94	+0.16	−0.20	+0.11	−0.23	+0.01	−0.46	−0.26	−0.96	−0.2	+0.2
29	Vienna	i Virginis	I	−0.93	+0.16	−0.21	+0.11	−0.24	+0.02	−0.46	−0.26	−0.96	−0.2	+0.2
29	Strassburg	i Virginis	I	−0.95	+0.16	−0.12	+0.07	−0.14	−0.02	−0.45	+0.06	−0.98	−0.9	−0.5
30	Vienna	43 H. Virginis	I	−0.93	+0.36	+0.08	−0.07	+0.10	−0.09	−0.37	−0.13	−0.93	−2.0	−1.6
July 13	Radcliffe	ε Piscium	IB	−0.87	−0.19	−0.44	+0.18	+0.47	+0.12	+0.47	+0.13	+0.88	−1.9	−1.5
16	Strassburg	Anon. 1	IB	−0.81	−0.58	+0.29	−0.61	−0.67	−0.33	+0.18	−0.56	+0.61	−3.3	−2.9
16	Strassburg	Anon. 1	E	+0.98	+0.69	+0.19	−0.41	−0.45	+0.09	+0.26	−0.39	−0.73	+0.7	+0.7
16	Strassburg	Anon. 7	E	+1.04	+0.74	+0.13	−0.29	−0.32	+0.13	−0.28	−0.28	−0.78	+2.6	+2.5
16	Strassburg	23 Tauri	IB	−1.08	−0.77	+0.05	−0.11	−0.12	−0.24	+0.27	−0.10	+0.81	−4.4	−3.9
16	Strassburg	23 Tauri	E	+1.08	+0.77	−0.06	+0.14	+0.15	+0.25	−0.25	+0.11	−0.81	+2.2	+2.1
16	Strassburg	Anon. 9	IB	−0.48	−0.34	+0.39	−0.81	−0.90	−0.31	+0.08	−0.74	+0.36	−1.7	−1.5
16	Strassburg	Anon. 8	IB	−0.43	−0.30	+0.40	−0.83	−0.92	−0.32	+0.07	−0.77	+0.32	−0.2	0.0
16	Strassburg	24 Tauri	IB	−1.02	−0.73	+0.15	−0.32	−0.36	−0.29	+0.24	−0.30	+0.76	−1.5	−1.0
16	Strassburg	η Tauri	IB	−1.04	−0.75	+0.12	−0.25	−0.28	−0.27	+0.25	−0.22	+0.79	−3.0	−2.5
16	Strassburg	Anon. 24	IB	−0.59	−0.43	+0.36	−0.76	−0.84	−0.33	+0.12	−0.65	+0.45	−7.8	−7.5
Oct. 5	Strassburg	ε Arietis	IB	−0.94	−0.49	+0.22	−0.36	−0.43	−0.28	+0.29	−0.32	+0.52	+1.4	+1.9
5	Strassburg	ε Arietis	E	+0.95	+0.50	+0.20	−0.34	−0.40	+0.02	−0.34	−0.30	−0.52	+0.4	+0.3
6	Strassburg	17 Tauri	IB	−0.97	−0.61	+0.14	−0.38	−0.41	−0.27	+0.23	−0.34	+0.64	+0.9	+1.4
6	Strassburg	17 Tauri	E	+1.05	+0.66	+0.05	−0.14	−0.15	+0.15	−0.28	−0.14	−0.69	+0.3	+0.2
6	Strassburg	23 Tauri	IB	−0.79	−0.50	−0.24	+0.62	+0.67	+0.03	+0.23	+0.58	+0.52	+4.1	+4.5
6	Strassburg	23 Tauri	E	+0.58	+0.37	−0.30	+0.78	+0.84	+0.30	−0.11	+0.70	−0.38	−0.2	−0.3
6	Strassburg	20 Tauri	IB	−0.43	−0.27	+0.33	−0.85	−0.92	−0.30	+0.08	−0.77	+0.29	+1.0	+1.2
6	Strassburg	20 Tauri	E	+0.70	+0.44	+0.27	−0.70	−0.75	−0.06	−0.21	−0.65	−0.46	+0.4	+0.3
6	Strassburg	24 Tauri	IB	−0.98	−0.62	−0.14	+0.37	+0.40	+0.08	+0.25	+0.35	+0.64	−0.9	−0.4
6	Strassburg	24 Tauri	E	+0.82	+0.52	−0.22	+0.60	+0.67	+0.30	−0.18	+0.52	−0.54	−0.3	−0.4
6	Strassburg	η Tauri	IB	−0.92	−0.59	−0.17	+0.36	+0.49	−0.04	+0.24	+0.42	+0.62	−0.2	+0.3
6	Strassburg	η Tauri	E	+0.75	+0.48	−0.25	+0.67	+0.71	+0.31	−0.17	+0.59	−0.50	−0.8	−0.9
6	Strassburg	Anon. 1	E	+1.01	+0.64	−0.11	+0.27	+0.29	+0.25	−0.26	+0.24	−0.67	−3.5	−3.6
6	Strassburg	Anon. 15	E	+0.87	+0.55	−0.20	+0.54	+0.58	+0.30	−0.21	+0.48	−0.57	+0.2	+0.1
6	Strassburg	Anon. 18	E	+0.88	+0.56	−0.19	+0.52	+0.56	+0.28	−0.20	+0.46	−0.58	+0.1	0.0
6	Strassburg	Anon. 24	E	+1.05	+0.66	−0.05	+0.13	+0.13	+0.21	−0.25	+0.10	−0.69	−1.4	−1.5
6	Strassburg	Anon. 27	E	+1.02	+0.64	−0.10	+0.26	+0.28	+0.25	−0.25	+0.22	−0.67	−1.7	−1.8
6	Strassburg	Anon. 29	E	+1.02	+0.64	−0.10	+0.26	+0.28	+0.24	−0.24	+0.22	−0.67	−1.5	−1.6
6	Strassburg	Anon. 31	E	+0.99	+0.62	−0.12	+0.34	+0.37	+0.25	−0.23	+0.29	−0.65	−1.0	−1.1
6	Strassburg	Anon. 32	E	+0.95	+0.60	−0.15	+0.41	+0.44	+0.26	−0.22	+0.35	−0.63	−0.1	−0.2
6	Strassburg	Anon. 37	E	+0.74	+0.47	−0.24	+0.67	+0.71	+0.30	−0.16	+0.59	−0.49	0.0	−0.1
6	Strassburg	Anon. 39	E	+0.96	+0.61	−0.14	+0.40	+0.42	+0.26	−0.22	+0.34	−0.64	+0.7	+0.6
6	Nr. Leipzig	23 Tauri	IB	−0.76	−0.48	−0.25	+0.65	+0.70	+0.04	+0.22	+0.60	+0.50	−2.1	−1.7
6	Nr. Leipzig	24 Tauri	IB	−0.96	−0.61	−0.15	+0.39	+0.43	−0.07	+0.25	+0.39	+0.64	−2.3	−1.8
6	Nr. Leipzig	η Tauri	IB	−0.90	−0.58	−0.18	+0.48	+0.52	−0.03	+0.24	+0.44	+0.60	0.0	+0.4
6	Nr. Leipzig	20 Tauri	IB	−0.47	−0.29	+0.32	−0.84	−0.89	−0.30	+0.08	−0.75	+0.31	+1.7	+1.9
6	Nr. Leipzig	17 Tauri	IB	−0.98	−0.62	+0.14	−0.36	−0.38	−0.26	+0.23	−0.31	+0.64	−0.2	+0.3
6	Nr. Leipzig	16 Tauri	IB	−0.36	−0.22	+0.34	−0.88	−0.94	−0.30	+0.05	−0.79	+0.23	−0.7	−0.5
6	Nr. Leipzig	16 Tauri	E	+0.62	+0.40	+0.29	−0.74	−0.81	−0.10	−0.18	−0.67	−0.42	+1.6	+1.5
6	Leipzig	17 Tauri	IB	−0.98	−0.62	+0.14	−0.36	−0.38	−0.26	+0.23	−0.31	+0.64	+2.5	+3.0
6	Leipzig	16 Tauri	IB	−0.36	−0.22	+0.31	−0.88	−0.94	−0.30	+0.05	−0.79	+0.23	−0.8	−0.6
6	Leipzig	23 Tauri	IB	−0.75	−0.48	−0.25	+0.65	+0.70	+0.05	+0.22	+0.62	+0.50	−2.7	−2.3
6	Leipzig	20 Tauri	IB	−0.48	−0.29	+0.32	−0.84	−0.89	−0.31	+0.08	−0.74	+0.31	+0.8	+1.0
6	Leipzig	η Tauri	IB	−0.90	−0.58	−0.19	+0.48	+0.52	−0.03	+0.24	+0.45	+0.60	−0.7	−0.3
6	Leipzig	Anon. 24	IB	−1.04	−0.66	+0.05	−0.15	−0.14	−0.21	+0.25	−0.11	+0.69	−1.2	−0.7
6	Leipzig	Anon. 29	IB	−1.06	−0.67	0.00	0.00	0.00	−0.17	+0.26	+0.02	+0.70	−2.0	−1.4
6	Leipzig	Anon. 32	IB	−1.06	−0.66	−0.06	+0.15	+0.17	−0.16	+0.27	+0.15	+0.69	−0.9	−0.4
6	Leipzig	16 Tauri	E	+0.62	+0.40	+0.29	−0.74	−0.81	−0.10	−0.18	−0.69	−0.42	+2.2	+2.1
6	Leipzig	17 Tauri	E	+1.05	+0.66	+0.04	−0.10	−0.12	+0.15	−0.27	−0.11	−0.69	+2.3	+2.1
6	Leipzig	23 Tauri	E	+0.55	+0.35	−0.30	+0.80	+0.86	+0.30	−0.10	+0.85	−0.36	−1.9	−2.0
6	Leipzig	20 Tauri	E	+0.73	+0.47	+0.26	−0.67	−0.72	+0.26	+0.14	−0.82	−0.49	+0.2	+0.1
6	Leipzig	η Tauri	E	+0.72	+0.46	−0.25	+0.68	+0.73	+0.29	−0.15	+0.60	−0.48	−1.2	−1.3
6	Leipzig	Anon. 24	E	+1.04	+0.66	−0.05	+0.15	+0.15	+0.21	−0.25	+0.11	−0.69	−1.8	−2.0
6	Kiel	17 Tauri	IB	−0.94	−0.59	+0.17	−0.44	−0.47	−0.28	+0.23	−0.40	+0.63	−0.4	−0.1
6	Kiel	17 Tauri	E	+1.03	+0.65	+0.08	−0.22	−0.24	+0.03	−0.28	−0.21	−0.68	+1.5	+1.3
6	Kiel	16 Tauri	IB	−0.01	−0.01	+0.36	−0.93	−1.00	−0.25	−0.03	−0.86	+0.01	−0.1	−0.1
6	Kiel	16 Tauri	E	+0.28	+0.17	+0.35	−0.90	−0.96	−0.19	−0.11	−0.83	−0.18	+1.0	+1.0
6	Kiel	23 Tauri	IB	−0.86	−0.55	−0.21	+0.54	+0.58	0.00	+0.23	+0.50	+0.57	−2.7	−2.3
6	Kiel	20 Tauri	E	+0.51	+0.32	+0.31	−0.82	−0.88	−0.13	−0.16	−0.75	−0.34	+3.4	+3.3
6	Kiel	24 Tauri	IB	−1.01	−0.64	−0.11	+0.28	+0.30	−0.01	+0.27	+0.27	+0.67	−3.0	−2.5
6	Kiel	24 Tauri	E	+0.90	+0.57	−0.19	+0.50	+0.53	+0.28	−0.20	+0.43	−0.60	+1.1	+1.0

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1876, Oct. 6	Kiel	η Tauri	IB	−0.98	−0.62	−0.14	+0.37	+0.39	−0.08	+0.25	+0.35	+0.64	+0.8	+1.3
6	Kiel	η Tauri	E	+0.84	+0.54	−0.21	+0.57	+0.61	+0.29	−0.20	+0.51	−0.56	+1.7	+1.6
6	Berlin	17 Tauri	IB	−0.98	−0.62	+0.14	−0.36	−0.38	−0.26	+0.24	−0.31	+0.65	−1.7	−1.2
6	Berlin	17 Tauri	E	+1.05	+0.66	+0.05	−0.12	−0.13	+0.15	−0.28	−0.13	−0.69	+1.4	+1.2
6	Berlin	16 Tauri	IB	−0.35	−0.22	+0.34	−0.88	−0.95	−0.29	+0.05	−0.79	+0.23	−0.4	−0.2
6	Berlin	16 Tauri	E	+0.61	+0.38	+0.29	−0.76	−0.82	−0.10	−0.19	−0.70	−0.40	+1.0	+0.9
6	Berlin	23 Tauri	IB	−0.76	−0.48	−0.25	+0.65	+0.69	+0.04	+0.23	+0.59	+0.50	−1.5	−1.1
6	Berlin	23 Tauri	E	+0.56	+0.36	−0.30	+0.79	+0.85	+0.30	−0.11	+0.71	−0.37	−1.2	−1.3
6	Berlin	20 Tauri	IB	−0.47	−0.29	+0.32	−0.84	−0.90	−0.30	+0.08	−0.74	+0.31	−0.2	−0.5
6	Berlin	η Tauri	IB	−0.91	−0.58	−0.18	+0.48	+0.51	−0.03	+0.26	+0.44	+0.60	−1.2	−0.7
6	Berlin	24 Tauri	IB	−0.96	−0.61	−0.15	+0.39	+0.42	−0.06	+0.26	+0.37	+0.64	+2.0	+2.5
6	Berlin	Anon. 24	IB	−1.05	−0.66	+0.05	−0.14	−0.15	−0.22	+0.27	−0.11	+0.69	+0.1	+0.6
6	Berlin	20 Tauri	E	+0.72	+0.46	+0.26	−0.69	−0.73	−0.05	−0.20	−0.63	−0.48	+0.6	+0.5
6	Berlin	η Tauri	E	+0.74	+0.47	−0.25	+0.67	+0.72	+0.30	−0.16	+0.60	−0.49	+0.6	+0.5
27	Washington	64 Aquarii	I	−0.73	+0.49	+0.62	−0.12	−0.63	−0.33	+0.28	+0.28	−0.64	+1.9	+2.3
Nov. 23	Washington	42 Aquarii	I	−0.86	+0.72	+0.33	−0.10	−0.34	−0.17	+0.37	+0.18	−0.94	−1.7	−1.3
24	Washington	81 Aquarii	I	−0.49	+0.32	+0.85	−0.05	−0.85	−0.42	+0.15	+0.27	−0.51	+1.1	+1.4
29	Greenwich	47 Arietis	I	−0.97	+0.40	−0.22	+0.38	+0.44	−0.05	+0.33	+0.31	−0.28	+1.8	+2.3
30	Nr. Leipzig	28 Tauri	I	−1.06	−0.60	+0.08	−0.25	−0.25	−0.28	+0.24	−0.21	−0.12	+0.2	+0.8
30	Nr. Leipzig	η Tauri	I	−0.88	−0.50	+0.18	−0.58	−0.60	−0.32	+0.19	−0.50	−0.10	+0.9	+1.4
30	Nr. Leipzig	26 Tauri	I	−0.81	−0.45	−0.20	+0.66	+0.68	−0.01	+0.21	+0.59	−0.09	−2.5	−2.0
30	Nr. Leipzig	27 Tauri	I	−1.10	−0.62	−0.01	+0.03	+0.03	+0.26	+0.27	+0.04	−0.12	−0.3	+0.3
30	Leipzig	η Tauri	I	−0.88	−0.50	+0.18	−0.57	−0.60	−0.32	+0.19	−0.50	−0.07	+0.4	+0.9
30	Leipzig	27 Tauri	I	−1.10	−0.62	−0.01	+0.03	+0.03	−0.22	+0.27	+0.04	−0.12	−2.5	−1.9
30	Leipzig	28 Tauri	I	−1.06	−0.60	+0.08	−0.25	−0.25	−0.28	+0.24	−0.21	−0.12	−0.8	−0.2
30	Leipzig	27 Tauri	EB	+1.07	+0.60	−0.07	+0.22	+0.23	+0.27	−0.24	+0.18	+0.12	−1.0	−1.2
Dec. 26	Washington	μ Arietis	I	−1.01	−0.36	+0.14	−0.24	−0.27	−0.26	+0.32	−0.17	−0.69	−0.6	0.0
1877, Jan. 30	Greenwich	45 Leonis	E	+0.88	+0.69	+0.63	+0.12	+0.64	−0.07	+0.40	+0.26	−0.26	0.0	−0.2
30	Greenwich	ρ Leonis	IB	−1.14	−0.89	−0.07	−0.01	−0.07	−0.24	−0.45	+0.02	+0.34	−1.3	−0.6
30	Greenwich	ρ Leonis	E	+1.10	+0.86	−0.25	−0.03	−0.25	+0.36	+4.40	−0.16	−0.33	−0.2	−0.4
Feb. 26	Greenwich	α Leonis	I	−1.13	−0.93	+0.07	+0.02	+0.07	−0.29	−0.42	+0.08	−0.18	−0.6	+0.1
Mar. 23	Strassburg	κ Geminor.	I	−0.80	−0.72	+0.45	+0.49	+0.67	−0.29	−0.15	+0.68	−0.67	−1.7	−1.1
26	Vienna	ρ Leonis	I	−0.93	−0.76	−0.55	−0.05	−0.55	+0.04	−0.43	−0.26	−0.44	−0.5	+0.2
26	Strassburg	ρ Leonis	EB	+0.88	+0.71	−0.61	−0.05	−0.61	+0.47	+0.28	−0.29	+0.41	−3.7	−4.0
Apr. 22	Washington	45 Leonis	I	−1.05	−0.90	−0.23	−0.02	−0.23	−0.10	0.00	−0.13	−0.83	−1.0	−0.3
26	Strassburg	85 Virginis	I	−0.59	−0.18	−0.52	−0.63	−0.82	+0.24	−0.30	+0.41	−0.11	−0.4	0.0
May 31	Strassburg	17 Capricor.	E	+0.82	−0.89	−0.37	−0.21	+0.42	+0.14	−0.28	−0.38	−0.76	−6.6	−6.9
July 6	Washington	16 Tauri	IB	−0.99	−0.23	+0.04	+0.31	+0.32	−0.08	+0.24	+0.28	−0.63	−2.0	−1.2
6	Washington	q Tauri	IB	−1.02	−0.24	+0.02	−0.19	−0.19	−0.19	+0.23	−0.14	−0.65	−3.0	−2.2
6	Washington	Anon. 4	I	−0.94	−0.22	−0.05	+0.42	+0.42	−0.05	+0.23	+0.41	−0.60	−3.3	−2.5
6	Washington	20 Tauri	IB	−0.97	−0.22	−0.05	+0.38	+0.37	−0.07	+0.23	+0.35	−0.61	−1.0	−0.2
6	Washington	21 Tauri	IB	−1.00	−0.23	+0.03	−0.28	−0.27	−0.21	+0.22	−0.21	−0.63	−3.7	−2.9
6	Washington	22 Tauri	IB	−1.03	−0.24	+0.02	−0.13	−0.13	−0.12	+0.23	−0.10	−0.65	−4.1	−3.3
6	Washington	Anon. 4	E	+0.77	+0.18	−0.08	+0.67	+0.68	+0.27	−0.16	+0.53	+0.48	+0.6	+0.3
6	Washington	q Tauri	E	+1.04	+0.24	−0.01	+0.12	+0.12	+0.19	−0.24	+0.08	+0.65	−3.1	−3.5
6	Washington	20 Tauri	E	+0.80	+0.18	−0.07	+0.63	+0.64	+0.26	−0.17	+0.53	+0.51	+1.9	+1.6
6	Washington	22 Tauri	E	+1.02	+0.24	−0.02	+0.21	+0.20	+0.20	−0.23	+0.16	+0.65	+1.9	+1.5
Aug. 29	Strassburg	μ Arietis	E	+0.86	−0.11	−0.14	−0.42	+0.44	+0.20	−0.28	+0.27	−0.85	+0.6	+0.2
30	Strassburg	21 Tauri	E	+0.59	+0.09	−0.05	−0.81	+0.80	+0.24	−0.11	+0.67	−0.59	−0.4	−0.7
Sept. 18	Vienna	30 Capricor.	I	−0.78	+0.84	+0.48	+0.13	−0.50	−0.18	+0.29	+0.46	−0.61	0.0	+0.7
25	Washington	μ Arietis	IB	−0.81	+0.18	−0.17	+0.51	+0.54	+0.10	+0.32	+0.39	+0.56	−3.4	−2.7
Nov. 20	Göttingen	17 Tauri	E	+0.40	−0.02	+0.01	+0.92	+0.92	+0.25	−0.06	+0.75	−0.02	+0.5	+0.3
20	Göttingen	q Tauri	IB	−0.91	+0.05	0.00	−0.43	−0.43	−0.20	+0.21	−0.34	+0.05	−2.2	−1.4
20	Göttingen	20 Tauri	IB	−1.00	+0.05	0.00	+0.11	+0.11	−0.10	+0.24	+0.14	+0.05	−1.9	−1.0
20	Göttingen	20 Tauri	E	+0.93	−0.05	+0.01	+0.38	+0.38	+0.19	−0.20	+0.29	−0.05	−0.7	−1.2
20	Greenwich	q Tauri	E	+0.94	−0.05	+0.01	−0.36	−0.36	+0.04	−0.01	−0.33	−0.05	−5.3	−5.8
20	Greenwich	20 Tauri	E	+0.99	−0.05	0.00	+0.19	+0.19	+0.16	−0.22	+0.13	−0.05	−0.6	−1.2
20	Greenwich	17 Tauri	E	+0.68	−0.03	+0.01	+0.74	+0.74	+0.25	−0.13	+0.60	−0.03	−3.8	−4.2
20	Strassburg	q Tauri	E	+1.00	−0.05	0.00	+0.07	−0.08	+0.10	−0.23	−0.10	−0.05	−2.8	−3.4
20	Strassburg	20 Tauri	E	+0.89	−0.04	0.00	−0.45	+0.45	+0.18	−0.19	+0.34	−0.04	−2.0	−2.5
22	Göttingen	136 Tauri	IB	−0.27	−0.10	−0.48	−0.86	−0.97	−0.02	−0.01	−0.95	+0.12	−5.6	−5.3
1878, Jan. 10	Vienna	51 Piscium	I	−0.80	+0.77	−0.32	+0.32	+0.45	+0.18	+0.45	−0.05	−0.89	−0.2	+0.6
Feb. 15	Strassburg	η Cancri	I	−0.58	−0.42	−0.81	−0.28	−0.86	+0.14	−0.21	−0.69	−0.17	−1.5	−0.9
15	Strassburg	η Cancri	E	+0.67	+0.47	−0.76	−0.27	−0.80	+0.38	+0.14	−0.72	+0.20	−1.6	−2.0
Mar. 7	Vienna	101 Piscium	I	−0.91	+0.73	−0.03	+0.08	+0.08	+0.01	+0.42	+0.09	−0.71	−2.7	−1.8
16	Strassburg	A Leonis	I	−0.60	−0.50	+0.84	+0.12	+0.85	−0.49	−0.13	+0.49	−0.20	+1.2	+1.8
16	Vienna	A Leonis	I	−0.85	−0.69	+0.67	−0.13	+0.68	−0.50	−0.23	+0.41	−0.28	+2.9	+3.8
16	Greenwich	A Leonis	I	−0.49	−0.41	+0.89	−0.12	+0.90	−0.49	−0.10	+0.51	−0.17	−0.9	−0.4
Apr. 9	Vienna	37 Geminor.	I	−1.00	−0.45	+0.12	+0.12	+0.15	−0.14	−0.15	+0.74	−0.99	−1.9	−0.8
13	Strassburg	48 Leonis	I	−1.11	−0.98	+0.05	+0.02	+0.05	−0.24	−0.43	+0.09	−0.67	+0.2	+1.4

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1878, May 26	Strassburg	51 Piscium	E	+1.12	−0.96	+0.10	+0.12	−0.16	+0.17	−0.45	−0.05	−0.81	+3.7	+2.9
June 5	Greenwich	π Cancri	I	−0.96	−0.72	+0.42	+0.01	+0.42	−0.30	−0.31	+0.36	−0.82	−0.5	+0.6
14	Washington	3 Sagittarii	I	−0.65	−0.09	+0.49	+0.61	−0.78	−0.10	+0.01	+0.81	−0.04	−1.2	−0.5
14	Washington	3 Sagittarii	EB	+0.40	+0.05	+0.58	+0.72	−0.92	+0.04	−0.01	+0.90	+0.02	+1.4	+1.1
27	Strassburg	χ Tauri	E	+0.98	−0.31	−0.02	+0.04	−0.04	+0.09	−0.15	−0.09	−0.41	+7.2	+6.5
Aug. 6	Vienna	4 Scorpii	I	−0.56	−0.35	+0.25	+0.79	−0.84	+0.08	−0.11	+0.75	−0.55	+0.3	+1.0
Sept. 5	Washington	σ Sagittarii	I	−0.83	−0.02	+0.44	+0.26	−0.51	−0.14	+0.13	+0.56	−0.80	+0.2	+1.2
6	Greenwich	51 Sagittarii	I	−0.88	+0.08	−0.37	−0.15	+0.40	+0.01	+0.22	−0.31	−0.82	+0.6	+1.7
6	Vienna	51 Sagittarii	I	−0.69	+0.06	−0.64	−0.25	+0.69	+0.10	+0.20	−0.61	−0.64	−1.2	−0.4
6	Strassburg	51 Sagittarii	I	−0.82	+0.08	−0.49	−0.19	+0.52	+0.04	+0.21	−0.44	−0.76	−1.7	−0.7
17	Washington	χ Tauri	E	+0.92	−0.39	+0.07	+0.16	+0.18	+0.07	−0.14	+0.09	−0.94	+3.6	+2.9
Oct. 5	Strassburg	θ Capricor.	I	−0.90	+0.41	+0.24	−0.01	−0.24	−0.11	+0.33	+0.24	−0.89	−2.3	−1.2
Nov. 10	Strassburg	17 Tauri	IB	−0.91	+0.67	+0.05	+0.12	+0.14	0.00	+0.19	+0.18	+0.22	−4.7	−3.6
10	Strassburg	17 Tauri	E	+0.84	−0.62	+0.14	+0.39	+0.41	+0.10	−0.17	+0.29	−0.20	+1.4	+0.7
10	Strassburg	16 Tauri	E	+0.89	−0.66	−0.09	−0.23	−0.26	−0.02	−0.19	−0.28	−0.21	−2.9	−3.7
10	Strasburg	20 Tauri	IB	−0.80	+0.58	−0.17	−0.49	−0.50	−0.13	+0.15	−0.38	+0.19	+2.9	+3.9
10	Strassburg	20 Tauri	E	+0.89	−0.65	−0.10	−0.26	−0.28	−0.02	−0.19	−0.30	−0.21	+2.0	+1.2
10	Greenwich	17 Tauri	IB	−0.92	+0.67	−0.05	−0.13	−0.14	−0.06	+0.20	−0.06	+0.22	−2.7	−1.6
10	Greenwich	17 Tauri	E	+0.92	−0.67	+0.05	+0.14	+0.15	+0.07	−0.20	+0.08	−0.22	+4.0	+3.2
10	Greenwich	20 Tauri	IB	−0.60	+0.44	−0.26	−0.71	−0.76	−0.17	+0.12	−0.61	+0.14	−1.1	−0.3
10	Greenwich	η Tauri	IB	−0.65	+0.48	+0.24	+0.67	+0.71	+0.11	+0.16	+0.64	+0.15	−0.9	−0.1
10	Washington	η Tauri	E	+0.91	−0.63	−0.07	−0.20	−0.21	0.00	−0.20	−0.25	−0.26	+2.1	+1.3
13	Washington	ϵ Geminor.	IB	−0.96	+0.05	−0.11	−0.06	−0.13	−0.06	−0.14	−0.08	+0.77	−1.7	−0.5
13	Washington	ϵ Geminor.	E	+0.96	−0.05	+0.14	+0.08	+0.16	+0.06	+0.14	+0.09	−0.77	+2.1	+1.3
13	Washington	ϵ Geminor.	IB	−0.96	+0.05	−0.11	−0.07	−0.13	−0.06	−0.13	−0.06	+0.78	−1.7	−0.5
13	Washington	ϵ Geminor.	E	+0.96	−0.05	+0.14	+0.08	+0.16	+0.06	+0.14	+0.09	−0.78	+3.0	+2.1
Dec. 2	Washington	λ Piscium	EB	+0.88	−0.91	−0.12	+0.13	+0.18	+0.16	−0.42	−0.08	+0.95	−1.2	−2.0
7	Washington	q Tauri	I	−0.94	+0.72	0.00	0.00	0.00	−0.06	+0.19	−0.04	−0.27	−3.2	−2.0
7	Washington	20 Tauri	I	−0.84	+0.64	+0.17	+0.42	+0.45	+0.03	+0.17	+0.48	−0 24	−1.0	+0.1
1879, Jan. 6	Strassburg	139 Tauri	I	−0.47	+0.14	+0.70	+0.55	+0.88	−0.10	−0.03	+0.91	−0.11	+0.1	+0.7
Feb. 3	Washington	ϵ Geminor.	I	−1.00	+0.14	−0.03	−0.01	−0.03	−0.11	−0.14	+0.04	−0.48	−4.8	−3.5
26	Vienna	26 Arietis	I	−0.89	+0.97	+0.02	+0.11	+0.11	+0.03	+0.32	+0.02	−0.91	−1.7	−0.5
28	Washington	χ Tauri	I	−0.75	+0.53	+0.32	+0.49	+0.59	+0.04	+0.11	+0.60	−0.81	−3.3	−2.3
28	Washington	χ Tauri	EB	+0.81	−0.57	+0.26	+0.39	+0.47	+0.07	−0.11	+0.37	+0.88	−1.0	−1.7
Apr. 1	Vienna	θ Cancri	I	−0.84	−0.18	−0.56	+0.04	−0.56	+0.08	−0.29	−0.38	−0.71	−3.1	−2.0
4	Strassburg	p^5 Leonis	IB	−0.96	+0.04	+0.30	−0.45	+0.52	−0.43	−0.30	+0.23	+0.82	−2.7	−1.5
25	Washington	125 Tauri	I	−0.89	+0.48	−0.19	−0.13	−0.23	−0.01	−0.03	−0.15	−0.84	−4.3	−3.1
26	Washington	52 B. Geminor.	I	−0.85	+0.25	−0.40	−0.16	−0.43	+0.01	−0.13	−0.36	−0.85	−3.7	−2.6
30	Greenwich	83 B. Leonis	I	−0.47	−0.24	+0.79	−0.41	+0.89	−0.42	−0.11	+0.52	−0.41	−0.2	+0.4
May 3	Greenwich	q Virginis	I	−0.72	−0.59	−0.26	+0.72	−0.77	+0.18	−0.35	+0.18	−0.30	+0.6	+1.5
28	Washington	34 Sextantis	I	−1.01	−0.64	−0.19	+0.16	−0.25	−0.03	−0.45	−0.01	−0.96	−3.3	−2.0
June 30	Washington	48 B. Scorpii	I	−1.08	−0.90	−0.15	+0.19	−0.25	−0.18	−0.15	+0.31	−0.59	−0.4	+1.0
July 28	Greenwich	α Scorpii	I	−0.38	−0.33	+0.65	+0.68	−0.94	+0.03	−0.05	+0.89	−0.30	+0.8	+1.3
28	Greenwich	α Scorpii	EB	+0.49	+0.41	+0.62	+0.64	−0.89	+0.16	+0.04	+0.79	+0.39	+1.3	+0.8
28	Strassburg	α Scorpii	I	−0.59	−0.50	+0.58	+0.60	−0.84	−0.02	−0.06	+0.83	−0.47	+0.3	+1.1
28	Strassburg	α Scorpii	EB	+0.73	+0.62	+0.52	+0.53	−0.74	+0.19	+0.07	+0.61	+0.59	−0.6	−1.3
Aug. 9	Strassburg	ϵ Arietis	E	+0.85	−0.95	+0.12	+0.30	+0.32	+0.08	−0.23	+0.16	−0.95	+1.2	+0.4
10	Strassburg	Anon. 17	E	+0.90	−0.61	−0.01	0.00	−0.01	+0.20	−0.13	−0.67	−0.98	+5.1	+4.2
10	Strassburg	Anon. 19	E	+0.86	−0.96	−0.17	−0.24	−0.30	−0.03	−0.17	−0.08	−0.94	+1.2	+0.4
10	Strassburg	27 Tauri	IB	−0.30	−0.92	−0.54	−0.78	−0.94	−0.15	−0.17	−0.33	+0.32	+0.6	+1.0
10	Strassburg	27 Tauri	E	+0.52	−0.57	−0.46	−0.66	−0.87	−0.14	−0.11	−0.73	−0.58	+3.3	+3.8
10	Strassburg	26 Tauri	E	+0.90	−0.96	−0.03	−0.04	−0.06	0.00	−0.17	−0.13	−0.98	+2.6	+1.7
10	Strassburg	Anon. 34	E	+0.66	−0.70	+0.39	+0.56	+0.68	+0.11	−0.12	+0.48	−0.71	+3.5	+2.9
10	Strassburg	Anon. 38	E	+0.87	−0.93	+0.15	+0.21	+0.26	+0.04	−0.16	+0.13	−0.95	+1.9	+1.1
10	Strassburg	Anon. 40	E	+0.90	−0.96	+0.05	+0.07	+0.09	+0.02	−0.17	−0.01	−0.98	+2.8	+1.9
25	Greenwich	142 B. Ophiuchi	I	−1.01	−0.83	+0.25	+0.18	−0.31	−0.15	−0.02	+0.38	−0.93	−0.4	+1.0
28	Washington	ν Capricor.	I	−0.51	−0.13	+0.85	−0.17	−0.87	−0.32	+0.48	+0.75	−0.29	+1.2	+1.9
Sept. 6	Washington	23 Tauri	IB	−0.82	+0.88	−0.24	−0.34	−0.42	−0.07	+0.15	−0.28	+0.87	−1.0	+0.1
6	Washington	η Tauri	IB	−0.71	+0.77	−0.36	−0.50	−0.61	−0.11	+0.12	−0.45	+0.76	−0.6	+0.4
6	Washington	23 Tauri	E	+0.90	−0.97	−0.03	−0.04	−0.06	0.00	−0.17	−0.12	−0.96	+2.2	+1.3
6	Washington	27 Tauri	IB	−0.90	+0.97	+0.04	+0.06	+0.07	0.00	+0.18	+0.15	+0.96	−2.1	−0.8
6	Washington	28 Tauri	IB	−0.87	+0.94	−0.15	−0.19	−0.25	−0.04	−0.18	−0.11	+0.93	−1.7	−0.5
6	Washington	24 Tauri	E	+0.82	−0.88	−0.24	−0.33	−0.41	−0.06	−0.17	−0.43	−0.87	+2.4	+1.6
6	Washington	η Tauri	E	+0.85	−0.92	−0.19	−0.27	−0.33	−0.05	−0.17	−0.37	−0.90	+2.0	+1.2
6	Washington	26 Tauri	E	+0.32	−0.35	+0.56	+0.74	+0.93	+0.15	−0.05	+0.74	−0.34	−2.8	−3.1
6	Washington	27 Tauri	E	+0.86	−0.93	+0.16	+0.22	+0.27	+0.04	−0.16	+0.16	−0.92	+0.9	+0.1
6	Washington	28 Tauri	E	+0.90	−0.97	−0.02	−0.03	−0.04	0.00	−0.18	−0.11	−0.96	+1.8	+0.9
26	Greenwich	λ Capricor.	I	−0.98	+0.02	+0.06	−0.04	−0.07	−0.11	+0.39	+0.11	−0.72	+0.6	+2.0
Oct. 4	Greenwich	36 Tauri	E	+0.90	−0.97	−0.07	−0.08	−0.10	0.00	−0.14	−0.15	−0.78	+3.1	+2.2
4	Strassburg	36 Tauri	E	+0.88	−0.96	+0.11	+0.12	+0.17	+0.02	−0.15	+0.07	−0.77	+3.7	+2.8

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1879, Oct. 24	Strassburg	θ Aquarii	I	−0.94	+0.02	+0.15	−0.13	−0.20	−0.14	+0.40	+0.15	−0.90	+0.6	+1.9
24	Strassburg	θ Aquarii	EB	+0.95	−0.02	−0.11	+0.10	+0.15	+0.12	−0.41	−0.14	+0.91	−3.5	−4.4
24	Berlin	θ Aquarii	I	−0.95	+0.02	+0.11	−0.12	−0.15	−0.12	+0.38	−0.35	−0.90	+0.1	+1.4
30	Strassburg	ε Arietis	E	+0.74	−0.83	−0.27	−0.48	−0.56	−0.14	−0.22	−0.45	−0.12	−8.2	−8.9
31	Cape	20 Tauri	E	+0.03	−0.93	+0.23	+0.29	+0.37	+0.06	−0.15	+0.31	−0.28	+0.3	−0.5
Nov. 16	Washington	λ Sagittarii	I	−0.35	−0.25	−0.92	−0.22	+0.95	+0.04	+0.05	−0.92	−0.20	−3.0	−2.5
16	Washington	λ Sagittarii	EB	+0.01	+0.01	−0.97	−0.23	+1.00	+0.12	+0.01	−0.99	+0.01	−0.5	−0.5
18	Greenwich	σ Capricor.	I	−1.04	−0.51	−0.16	+0.04	+0.17	−0.14	+0.30	−0.07	−0.83	−1.0	+0.4
22	Greenwich	16 Piscium	I	−0.77	+0.34	+0.23	−0.52	−0.57	−0.27	+0.30	+0.13	−0.78	+0.5	+1.6
Dec. 1	Washington	δ Geminor.	IB	−0.82	+0.50	−0.45	−0.01	−0.45	+0.07	−0.19	−0.36	+0.61	−2.0	−0.9
1	Washington	δ Geminor.	E	+0.82	−0.50	−0.45	0.00	−0.45	+0.11	+0.18	−0.51	−0.61	+0.4	−0.4
22	Greenwich	101 Piscium	I	−0.61	+0.52	+0.12	+0.73	+0.74	+0.25	+0.29	+0.28	−0.63	−0.3	+0.6
27	Nr. Leipzig	132 Tauri	I	−0.85	+0.84	+0.32	+0.12	+0.34	+0.01	−0.05	+0.42	−0.15	−3.0	−1.8
1880, Jan. 16	Strassburg	19 Piscium	I	−0.96	+0.31	+0.05	−0.15	−0.16	−0.13	+0.40	+0.09	−0.81	−1.1	−0.2
20	Greenwich	ε Arietis	I	−0.82	+0.87	−0.21	−0.34	−0.40	−0.06	+0.17	−0.18	−0.88	+1.2	+2.3
28	Strassburg	π Leonis	IB	−0.94	+0.04	−0.24	+0.22	−0.33	+0.05	−0.40	−0.09	+0.40	−5.3	−4.0
28	Strassburg	π Leonis	E	+0.80	−0.03	−0.43	+0.40	−0.59	+0.30	+0.27	−0.39	−0.34	−0.4	−1.2
28	Nr. Leipzig	π Leonis	I	−0.81	+0.03	−0.42	+0.38	−0.57	+0.16	−0.37	−0.29	+0.35	−5.5	−4.4
28	Nr. Leipzig	π Leonis	E	+0.62	−0.02	−0.57	+0.54	−0.78	+0.36	+0.18	−0.29	−0.26	+0.2	−0.4
Feb. 5	Cape	θ Ophiuchi	IB	−1.09	−0.97	+0.02	+0.01	−0.02	−0.19	0.00	+0.03	+0.83	−0.2	+1.3
5	Cape	θ Ophiuchi	E	+1.03	+0.92	+0.30	+0.14	−0.33	+0.18	−0.01	+0.34	−0.79	+1.3	+0.3
12	Strassburg	9 Piscium	I	−0.98	+0.19	−0.08	+0.20	+0.21	−0.01	+0.44	+0.04	−0.38	−2.8	−1.4
18	Cape	χ Tauri	I	−0.89	+0.99	−0.12	−0.09	−0.14	−0.02	+0.11	−0.08	−0.98	−2.5	−1.3
18	Nr. Leipzig	62 Tauri	I	−0.75	+0.84	+0.44	+0.33	+0.55	+0.06	+0.10	+0.57	−0.83	−3.9	−2.8
Mar. 3	Cape	26 Ophiuchi	E	+0.69	+0.63	−0.67	−0.36	+0.77	+0.09	+0.03	−0.79	−0.64	+0.7	0.0
4	Cape	7 Sagittarii	E	+1.04	+0.92	+0.19	+0.05	−0.20	+0.14	−0.08	+0.11	−0.95	+1.9	+0.9
4	Cape	9 Sagittarii	E	+1.07	+0.94	−0.03	−0.01	+0.03	+0.17	−0.08	−0.12	−0.97	−0.7	−1.8
13	Greenwich	101 Piscium	I	−0.78	+0.63	+0.10	+0.41	+0.42	+0.18	+0.33	+0.26	−0.45	−2.0	−0.9
13	Nr. Leipzig	101 Piscium	I	−0.88	+0.66	+0.08	+0.32	+0.34	+0.09	+0.36	+0.22	−0.47	−0.4	+0.8
18	Strassburg	132 Tauri	I	−0.83	+0.88	−0.36	−0.10	−0.38	+0.03	−0.04	−0.29	−0.93	−2.7	−1.5
18	Nr. Leipzig	132 Tauri	I	−0.92	+0.77	−0.56	−0.26	−0.59	−0.15	−0.04	−0.52	−0.81	−1.0	+0.3
21	Strassburg	d^2 Cancri	I	−0.85	+0.47	−0.43	+0.16	−0.46	+0.09	−0.29	−0.22	−0.68	−2.9	−1.7
21	Greenwich	d^2 Cancri	I	−0.82	+0.45	−0.47	+0.18	−0.50	+0.11	−0.29	−0.34	−0.67	−1.0	+0.1
25	Nr. Leipzig	13 B. Virginis	I	−0.94	−0.34	+0.11	−0.46	+0.47	−0.34	−0.32	+0.02	−0.02	−1.7	−0.4
30	Cape	B. A. C. 5641	E	+1.04	+0.95	−0.28	−0.15	+0.31	+0.18	+0.05	−0.39	−0.85	−0.9	−1.9
Apr. 1	Cape	ν^2 Sagittarii	E	+1.06	+0.90	+0.02	0.00	−0.02	+0.16	−0.17	−0.07	−1.00	+1.2	+0.1
2	Cape	f Sagittarii	E	+1.05	+0.79	+0.02	0.00	−0.02	+0.14	−0.25	+0.01	−0.98	−0.1	−1.1
11	Strassburg	47 Arietis	I	−0.87	+0.86	−0.18	−0.25	−0.31	−0.07	+0.22	−0.15	−0.39	−1.0	+0.2
16	Greenwich	56 Geminor.	I	−0.56	+0.46	+0.78	−0.10	+0.79	−0.15	−0.12	−0.65	−0.62	−2.4	−1.6
20	Washington	36 Sextantis	I	−0.91	−0.08	+0.22	−0.38	+0.44	−0.28	−0.34	+0.23	−0.60	−2.3	−1.0
20	Washington	36 Sextantis	EB	+1.02	+0.09	+0.02	−0.03	+0.03	+0.10	+0.43	−0.06	+0.67	−1.8	−2.8
26	Cape	19 Scorpii	E	+1.08	+0.94	−0.26	−0.18	+0.32	+0.20	+0.11	−0.37	−0.48	−0.6	−1.7
May 18	Greenwich	p^2 Leonis	I	−1.00	−0.16	+0.03	+0.06	+0.07	−0.12	−0.41	+0.09	−0.90	−2.5	−1.1
26	Cape	o Sagittarii	IB	−1.12	−0.91	−0.06	0.00	+0.06	−0.21	+0.19	−0.07	+0.59	−1.8	−0.2
June 13	Cape	83 B. Leonis	I	−0.43	+0.12	−0.58	+0.68	−0.89	+0.32	−0.25	−0.45	−0.42	−3.7	−3.1
13	Cape	89 B. Leonis	I	−0.91	+0.25	+0.18	−0.21	+0.28	−0.15	−0.35	+0.23	−0.90	−0.2	+1.1
13	Cape	89 B. Leonis	EB	+0.95	−0.26	−0.02	+0.03	−0.03	+0.06	+0.39	−0.38	+0.94	−5.6	−6.5
14	Cape	34 Sextantis	I	−0.96	+0.04	+0.04	−0.08	+0.09	−0.10	−0.40	+0.09	−1.00	−3.2	−1.8
18	Cape	43 H. Virginis	I	−1.04	−0.76	+0.15	+0.27	−0.31	−0.10	−0.30	+0.27	−0.67	−2.9	−1.4
20	Cape	19 Scorpii	I	−1.03	−0.88	−0.37	−0.23	+0.44	−0.27	−0.08	−0.32	−0.33	+0.7	+2.1
21	Cape	39 Ophiuchi	I	−1.11	−0.96	−0.26	−0.09	+0.28	−0.24	+0.01	−0.18	−0.19	−0.9	+0.6
25	Cape	c^1 Capricor.	IB	−1.04	−0.52	−0.16	+0.17	+0.23	−0.08	+0.39	−0.07	+0.67	−0.4	+1.1
25	Cape	c^1 Capricor.	E	+0.86	+0.43	−0.41	+0.44	+0.60	+0.37	−0.25	−0.43	−0.55	−0.1	−1.0
30	Cape	4 Arietis	E	+0.70	−0.41	−0.25	−0.61	−0.65	−0.19	−0.28	−0.39	−0.74	+0.1	−0.6
July 17	Nr. Leipzig	31 B. Scorpii	I	−1.09	−0.93	−0.09	−0.06	+0.11	−0.20	−0.15	−0.03	−0.78	−0.6	+0.9
19	Cape	4 Sagittarii	EB	+0.82	+0.71	+0.69	+0.09	−0.69	+0.12	−0.07	+0.61	+0.34	−5.5	−6.3
19	Cape	1 Sagittarii	I	−1.02	−0.89	−0.44	−0.03	+0.44	−0.18	+0.09	−0.36	−0.42	+1.4	+2.8
20	Cape	o Sagittarii	I	−1.14	−0.95	+0.01	0.00	−0.01	−0.24	+0.19	+0.02	−0.31	−0.1	+1.5
20	Cape	o Sagittarii	EB	+1.12	+0.93	+0.18	−0.02	−0.18	+0.20	−0.19	+0.20	+0.30	−1.2	−2.3
27	Cape	η Piscium	E	+0.92	−0.41	+0.08	+0.21	+0.23	+0.12	−0.31	+0.01	−0.92	−0.9	−1.8
30	Cape	36 Tauri	E	+0.47	−0.47	+0.71	+0.47	+0.85	+0.10	−0.06	+0.77	+0.49	+0.3	−0.2
Aug. 16	Cape	28 Sagittarii	I	−1.10	−0.96	+0.13	−0.01	−0.13	−0.23	−0.41	+0.10	−0.70	−0.4	+1.1
16	Cape	30 Sagittarii	I	−1.02	−0.90	+0.38	+0.04	+0.38	−0.13	+0.16	−0.29	−0.66	+1.2	+2.6
16	Cape	31 Sagittarii	I	−1.10	−0.97	+0.10	−0.01	−0.10	−0.21	+0.16	+0.19	−0.71	−0.1	+1.4
28	Nr. Leipzig	121 Tauri	IB	−0.81	+0.90	−0.42	−0.08	−0.42	+0.03	−0.03	−0.34	+0.85	−3.9	−2.8
Sept. 11	Berlin	θ Ophiuchi	I	−0.28	−0.26	+0.94	+0.21	−0.96	−0.04	0.00	+0.96	−0.26	+0.5	+0.9
12	Washington	117 B. Sagittarii	I	−0.85	−0.77	+0.61	−0.05	−0.61	−0.21	+0.11	+0.67	−0.75	+1.0	+2.2
13	Greenwich	50 Sagittarii	I	−0.79	−0.69	−0.65	+0.19	+0.68	+0.03	+0.17	−0.59	−0.67	−1.4	−0.3
14	Washington	47 B. Capricor.	I	−0.42	−0.31	+0.78	−0.49	−0.92	−0.34	+0.08	+0.79	−0.29	+1.1	+1.7
17	Washington	κ Piscium	I	−0.80	−0.14	−0.13	+0.62	+0.64	+0.16	+0.38	−0.02	−0.12	−2.6	−1.5

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1880, Sept. 25	Nr. Leipzig	1 Geminor.	IB	-0.82	+0.91	+0.40	-0.02	+0.41	-0.04	-0.08	-0.34	+0.91	-3.7	-2.6
25	Nr. Leipzig	1 Geminor.	E	+0.88	-0.98	-0.21	-0.01	-0.21	0.00	-0.50	-0.29	-0.98	+4.4	+3.5
Oct. 7	Cape	δ Scorpii	I	-0.58	-0.46	+0.74	+0.42	-0.85	+0.01	-0.09	+0.71	-0.38	+0.1	+0.9
10	Cape	π Sagittarii	I	-0.81	-0.74	-0.64	+0.16	+0.66	-0.01	+0.17	-0.59	-0.76	-1.4	-0.3
10	Cape	π Sagittarii	EB	+0.52	+0.47	-0.84	+0.22	+0.87	+0.23	-0.07	-0.88	+0.48	-3.3	-3.8
15	Strassburg	16 Piscium	I	-0.97	-0.13	+0.04	-0.29	-0.29	-0.21	+0.37	+0.11	-0.46	+1.2	+2.6
Nov. 17	Greenwich	υ Tauri	IB	-0.95	+0.81	+0.28	+0.12	+0.31	-0.05	+0.09	+0.37	+0.12	-4.7	-3.3
19	Greenwich	η Geminor.	IB	-0.89	+0.99	-0.17	+0.01	-0.17	+0.03	-0.10	-0.10	+0.54	-3.0	-1.7
19	Greenwich	μ Geminor.	IB	-0.70	+0.78	-0.63	+0.05	-0.63	+0.07	-0.09	-0.57	+0.43	-1.7	-0.7
19	Greenwich	μ Geminor.	E	+0.65	-0.72	-0.69	+0.06	-0.69	+0.06	+0.08	-0.75	-0.40	+1.7	+1.0
20	Greenwich	ζ Geminor.	IB	-0.89	+0.98	+0.16	+0.04	+0.16	-0.02	-0.18	+0.24	+0.69	-7.6	-6.3
20	Greenwich	ζ Geminor.	E	+0.84	-0.92	+0.35	+0.09	+0.36	-0.07	+0.18	+0.27	-0.65	+2.6	+1.8
Dec. 12	Cape	26 Arietis	I	-0.88	+0.39	-0.23	-0.26	-0.35	-0.12	+0.23	-0.12	-0.70	-2.6	-1.4
1881, Jan. 5	Berlin	19 Piscium	I	-0.35	-0.13	+0.02	+0.94	+0.94	+0.33	+0.21	-0.04	-0.32	-3.7	-3.2
5	Greenwich	19 Piscium	I	-0.49	-0.17	+0.02	+0.88	+0.88	+0.28	+0.26	-0.02	-0.42	-1.4	-0.7
7	Washington	101 Piscium	I	-0.95	+0.16	-0.07	-0.12	-0.14	-0.09	+0.31	+0.03	-0.99	-1.6	-0.2
9	Strassburg	ζ Arietis	I	-0.62	+0.34	-0.60	-0.43	-0.74	-0.13	+0.12	-0.50	-0.62	-0.9	0.0
12	Greenwich	394 B. Tauri	I	-0.90	+0.93	-0.05	0.00	-0.05	+0.02	-0.05	+0.02	-0.52	-3.8	-2.5
Feb. 6	Washington	32 Tauri	I	-0.92	+0.67	+0.02	+0.01	+0.02	-0.01	+0.14	+0.10	-0.99	-3.4	-2.3
Mar. 8	Cape	1 Geminor.	I	-0.11	+0.11	+0.99	-0.12	+0.99	-0.07	-0.01	+0.98	-0.12	+0.4	+0.6
8	Greenwich	14 B. Geminor.	I	-0.90	+0.93	+0.04	-0.01	+0.04	+0.01	-0.09	+0.12	-0.98	-3.9	-2.6
16	Greenwich	q Virginis	IB	-0.90	+0.08	+0.38	+0.19	-0.42	+0.06	-0.20	+0.16	+0.20	-0.5	+0.8
16	Greenwich	q Virginis	E	+0.63	-0.06	+0.69	+0.35	-0.77	+0.33	+0.18	+0.12	-0.14	+1.0	+0.4
18	Cape	40 H. Virginis	E	+0.68	+0.22	+0.49	+0.55	-0.74	+0.27	+0.15	+0.42	-0.45	+1.8	+1.1
May 4	Greenwich	5 Cancri	I	-0.90	+1.00	-0.05	+0.04	-0.06	+0.04	-0.27	-0.28	-1.00	-5.9	-4.6
11	Berlin	75 Virginis	I	-0.55	-0.05	-0.49	-0.69	+0.84	-0.33	-0.12	-0.29	-0.17	-1.6	-0.8
21	Washington	16 Piscium	E	+0.81	+0.46	+0.02	+0.61	+0.61	+0.32	-0.26	-0.14	-0.73	+1.9	+1.1
July 5	Strassburg	83 Virginis	I	-0.89	-0.12	-0.30	-0.34	+0.46	-0.21	-0.26	-0.18	-0.80	+1.9	+3.1
18	Washington	27 Arietis	E	+0.72	-0.02	-0.54	-0.42	-0.68	-0.12	-0.21	-0.48	-0.72	-0.1	-0.8
Aug. 15	Washington	δ Arietis	IB	-0.93	+0.11	-0.28	-0.14	-0.32	-0.12	+0.19	-0.15	+0.93	-1.2	+0.1
15	Washington	δ Arietis	E	+0.98	-0.12	+0.01	0.00	+0.01	+0.06	-0.20	-0.09	-0.98	+3.0	+2.1
Sept. 3	Greenwich	33 Sagittarii	I	-0.90	-0.75	+0.51	-0.26	-0.57	-0.23	+0.12	+0.62	-0.70	+1.0	+2.3
Oct. 3	Cape	19 Aquarii	I	-0.82	-0.73	+0.27	-0.61	-0.67	-0.36	+0.20	+0.50	-0.58	+1.3	+2.4
5	Greenwich	κ Piscium	I	-1.09	-0.77	-0.03	-0.20	-0.20	-0.26	+0.36	+0.10	-0.42	+0.5	+2.0
5	Greenwich	9 Piscium	I	-1.03	-0.72	+0.06	+0.38	+0.30	-0.03	+0.38	+0.02	-0.40	+0.5	+1.9
9	Greenwich	54 Arietis	E	+0.46	0.00	+0.83	+0.36	+0.90	+0.23	-0.07	+0.63	-0.17	+0.2	-0.2
31	Cape	138 B. Aquarii	I	-1.08	-0.96	0.00	+0.02	+0.02	-0.15	+0.36	+0.08	-0.93	-1.1	+0.4
Nov. 1	Cape	3 Piscium	I	-0.64	-0.53	-0.06	-0.80	-0.80	-0.39	+0.15	+0.27	-0.52	-0.1	+0.9
12	Greenwich	α Cancri	IB	-0.89	+0.98	-0.08	+0.15	-0.17	+0.07	-0.31	-0.03	+0.97	-6.7	-5.5
12	Greenwich	α Cancri	E	+0.88	-0.97	-0.01	+0.18	-0.20	+0.04	+0.30	-0.25	-0.96	+1.7	+0.9
29	Greenwich	16 Piscium	I	-1.04	-0.82	+0.05	+0.19	+0.20	-0.06	+0.38	+0.04	-0.95	-2.0	-0.6
29	Greenwich	19 Piscium	I	-1.05	-0.84	0.00	0.00	0.00	-0.12	+0.36	+0.09	-0.97	-1.5	-0.1
Dec. 24	Cape	ξ Aquarii	I	-0.92	-0.83	+0.14	-0.54	-0.55	-0.34	+0.26	+0.43	-0.61	+1.7	+3.0
27	Cape	d Piscium	I	-1.04	-0.78	-0.03	-0.06	-0.07	-0.15	+0.35	+0.10	-1.00	-1.2	+0.2
30	Greenwich	45 Arietis	I	-0.97	-0.22	-0.17	-0.07	-0.18	-0.10	+0.21	-0.06	-0.86	-1.5	-0.1
1882, Feb. 7	Cape	χ Virginis	E	+0.88	-0.64	+0.15	+0.21	-0.26	+0.08	+0.31	+0.12	-0.82	+1.5	+0.7
11	Cape	ω^2 Scorpii	E	+0.99	+0.22	-0.15	-0.01	+0.15	+0.07	+0.11	-0.15	-0.93	+1.3	+0.4
12	Cape	116 B. Ophiuchi	E	+1.03	+0.44	+0.09	-0.02	-0.09	+0.11	+0.02	+0.01	-0.85	+3.0	+2.1
Mar. 8	Cape	621 B. Virginis	E	+0.93	-0.37	-0.12	-0.07	+0.14	-0.01	+0.28	-0.15	-0.77	+1.3	+0.5
Apr. 1	Greenwich	e Leonis	I	-0.03	+0.03	-0.35	-0.94	+1.00	-0.37	+0.06	+0.15	+0.01	-0.1	-0.1
20	Cape	247 B. Tauri	I	-0.81	-0.06	+0.61	-0.06	+0.61	-0.03	+0.06	+0.52	-0.42	-3.3	-2.3
May 6	Cape	16 Sagittarii	E	+1.01	+0.49	-0.15	+0.09	+0.18	+0.12	-0.09	-0.19	-0.77	+0.2	-0.6
29	Cape	621 B. Virginis	I	-0.96	+0.52	-0.05	-0.03	+0.06	-0.06	-0.26	+0.05	-0.51	-3.7	-2.4
June 4	Cape	g Sagittarii	E	+0.77	+0.46	+0.37	-0.60	-0.70	-0.05	-0.20	+0.55	-0.42	-1.5	-2.1
July 2	Cape	β Capricor.	IB	-0.12	+0.08	-0.44	-0.89	+0.99	+0.23	+0.06	-0.82	+0.04	+0.4	+0.6
21	Cape	χ Virginis	I	-0.87	+0.85	+0.18	-0.18	-0.26	+0.11	-0.34	+0.11	-0.93	-1.7	-0.6
Aug. 2	Greenwich	22 Piscium	E	+1.06	+0.94	-0.17	-0.27	-0.32	+0.06	-0.28	-0.04	-0.66	+0.9	0.0
18	Cape	50 Virginis	I	-0.85	+0.78	+0.28	-0.20	-0.35	+0.13	-0.32	+0.16	-0.77	-2.9	-1.9
27	Cape	19 Aquarii	I	-1.11	-0.88	-0.03	+0.21	+0.22	-0.14	+0.32	-0.07	-0.23	+0.4	+1.7
27	Cape	ξ Aquarii	I	-0.36	-0.28	+0.03	-0.95	-0.95	-0.37	+0.04	+0.60	-0.07	+0.3	+0.7
Sept. 7	Cape	5 Cancri	E	+0.67	-0.38	+0.31	-0.62	+0.69	-0.15	+0.18	+0.64	-0.59	+4.1	+3.6
20	Greenwich	μ Sagittarii	I	-0.91	-0.28	-0.32	+0.26	+0.41	-0.03	+0.08	-0.34	-0.89	-0.3	+0.7
20	Washington	21 Sagittarii	I	-1.01	-0.31	+0.09	-0.08	-0.12	-0.10	+0.11	+0.19	-0.97	-0.5	+0.6
Oct. 1	Greenwich	l Tauri	E	+0.69	+0.18	-0.67	+0.29	-0.73	+0.04	-0.01	-0.76	-0.57	-1.0	-1.5
22	Greenwich	κ Aquarii	I	-0.56	-0.48	+0.25	+0.83	+0.86	+0.21	+0.22	-0.31	-0.38	-1.8	-1.2
24	Greenwich	51 Piscium	I	-0.37	-0.32	+0.69	+0.64	+0.94	-0.25	+0.04	-0.11	-0.14	+3.2	+3.6
Nov. 2	Strassburg	κ Cancri	IB	-0.83	+0.57	-0.06	+0.42	-0.43	+0.14	-0.28	-0.37	+0.90	-2.9	-1.9
2	Strassburg	κ Cancri	E	+0.83	-0.57	-0.05	+0.44	-0.44	+0.11	+0.24	-0.34	-0.90	+2.4	+1.8
18	Cape	138 B. Aquarii	I	-0.72	-0.61	-0.15	-0.72	-0.74	-0.34	+0.17	+0.40	-0.66	+0.9	+1.7
18	Cape	B. D.$-5°$ 5738	I	-0.10	-0.09	-0.19	-0.98	-1.00	-0.34	-0.04	+0.48	-0.10	+3.7	+3.8

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1882, Nov. 26	Hamburg	64 Orionis	IB	−0.98	−0.10	−0.24	+0.20	−0.31	−0.07	−0.07	−0.26	+0.28	−0.9	+0.2
26	Hamburg	64 Orionis	E	+1.00	+0.10	−0.20	+0.16	−0.25	+0.11	+0.07	−0.33	−0.29	−1.2	−1.9
Dec. 5	Cape	α Virginis	IB	−0.49	+0.51	−0.75	−0.39	+0.85	−0.24	−0.11	−0.29	+0.41	−0.6	−0.1
5	Cape	α Virginis	E	+0.67	−0.71	−0.60	−0.31	+0.68	−0.21	+0.25	−0.30	−0.57	+1.2	+0.7
1883, Jan. 4	Strassburg	κ Libræ	IB	−0.85	+0.49	+0.45	−0.06	−0.46	+0.05	−0.13	+0.38	+0.63	−1.9	−1.0
4	Hamburg	κ Libræ	I	−0.70	+0.40	+0.67	−0.09	−0.68	+0.09	−0.11	+0.57	+0.52	−0.6	+0.2
11	Hamburg	117 G. Capricor.	I	−0.87	−0.64	+0.07	+0.60	+0.60	+0.29	+0.28	−0.40	−0.47	−2.2	−1.2
11	Hamburg	c^1 Capricor.	I	−0.65	−0.47	+0.10	+0.80	+0.81	−0.06	+0.23	−0.44	−0.35	−0.7	0.0
12	Strassburg	κ Aquarii	I	−1.07	−0.89	+0.07	+0.19	+0.20	−0.08	+0.33	−0.08	−0.72	+0.3	+1.4
13	Hamburg	15 Piscium	I	−1.06	−0.95	−0.15	−0.20	−0.25	−0.24	+0.31	+0.09	−0.85	−0.2	+0.9
Feb. 14	Cape	164 B. Tauri	IB	−0.88	−0.08	+0.51	−0.14	+0.53	−0.16	−0.09	−0.40	+0.43	−1.9	−0.9
Mar. 12	Greenwich	o Arietis	I	−1.00	−0.80	+0.43	+0.01	+0.43	−0.06	+0.21	+0.34	−0.67	−1.0	0.0
Apr. 17	Washington	36 Sextantis	I	−0.89	+0.76	+0.09	+0.19	−0.19	+0.10	−0.35	−0.03	−0.73	−1.7	−0.8
28	Cape	54 Sagittarii	E	+0.43	+0.11	−0.30	+0.85	+0.90	+0.18	−0.06	−0.87	−0.44	−1.6	−1.9
May 13	Cape	h Leonis	I	−0.84	+0.42	+0.08	+0.45	−0.46	+0.12	−0.29	−0.22	−0.88	−1.5	−0.7
17	Strassburg	χ Virginis	I	−0.90	+0.99	+0.05	+0.03	−0.06	+0.06	−0.33	−0.02	−0.72	−1.5	−0.6
June 14	Washington	62 Virginis	I	−0.31	+0.81	−0.89	−0.18	+0.94	+0.28	−0.21	−0.20	−0.72	−1.0	−0.7
July 15	Nikolaieff	β Scorpii	I	−0.82	+0.68	−0.42	−0.19	+0.46	−0.04	−0.11	−0.36	−0.65	+0.9	+1.7
17	Greenwich	16 G. Sagittarii	I	−0.87	+0.32	+0.29	−0.36	−0.46	−0.05	+0.04	+0.51	−0.33	−1.6	−0.7
19	Cape	e Sagittarii	I	−1.02	−0.04	+0.05	−0.17	−0.17	−0.16	+0.26	+0.19	+0.01	+0.3	+1.3
21	Washington	c^2 Capricor.	E	+1.04	+0.53	+0.06	+0.20	+0.20	+0.17	−0.27	−0.16	−0.47	−1.2	−1.8
Aug. 24	Greenwich	148 B. Tauri	E	+1.06	+0.90	−0.05	+0.02	−0.05	+0.11	−0.14	−0.08	−0.99	+1.7	+1.1
Sept. 6	Washington	α Libræ	I	−0.51	+0.55	+0.81	−0.12	−0.82	+0.20	−0.14	+0.59	−0.50	−0.1	+0.4
6	Washington	α Libræ	EB	+0.55	−0.62	+0.74	−0.12	−0.76	+0.09	+0.11	+0.48	+0.56	−1.5	−1.8
6	Washington	8 Libræ	I	−0.26	+0.28	+0.95	−0.15	−0.95	+0.21	−0.08	+0.67	−0.26	+2.6	+2.9
7	Cape	32 Libræ	I	−0.64	+0.64	+0.67	−0.22	−0.71	+0.14	−0.14	+0.51	−0.67	−2.2	−1.6
14	Greenwich	c^1 Capricor.	I	−0.24	−0.11	−0.32	−0.91	−0.98	−0.32	+0.03	+0.60	−0.09	−0.2	0.0
14	Greenwich	c^2 Capricor.	I	−1.08	−0.48	+0.02	+0.06	+0.06	−0.12	+0.30	+0.01	−0.41	−0.4	+0.6
16	Washington	21 Piscium	I	−0.62	−0.45	+0.66	+0.53	+0.84	+0.17	+0.23	−0.05	+0.03	−4.1	−3.5
Oct. 23	Prague	κ Cancri	IB	−0.91	−0.04	+0.07	+0.33	−0.34	+0.07	−0.25	−0.32	+0.93	−3.4	−2.6
23	Prague	κ Cancri	E	+0.90	+0.04	+0.08	+0.35	−0.36	+0.11	+0.23	−0.26	−0.92	−1.3	−1.8
Nov. 13	Cape	29 Arietis	I	−1.08	−0.93	−0.36	+0.04	−0.36	−0.29	+0.20	−0.18	−0.23	−0.6	+0.4
1884, Jan. 2	Cape	44 Aquarii	I	−1.01	−0.42	+0.04	+0.05	+0.06	−0.05	0.00	+0.01	−0.83	+1.1	+2.0
7	Cape	o Arietis	I	−0.71	−0.66	+0.73	−0.17	+0.76	+0.06	+0.18	+0.53	−0.59	−2.4	−1.8
Feb. 6	Greenwich	120 Tauri	I	−1.07	−0.84	+0.04	−0.06	+0.07	−0.13	+0.01	+0.12	−0.82	−0.8	+0.2
6	Prague	119 Tauri	I	−1.07	−0.84	−0.04	+0.06	−0.07	−0.12	0.00	−0.03	−0.82	−1.4	−0.4
6	Prague	120 Tauri	I	−1.07	+0.83	+0.04	−0.06	+0.08	−0.13	0.00	−0.19	−0.82	−0.1	+0.9
6	Prague	119 Tauri	EB	+1.06	−0.84	−0.10	+0.14	−0.17	+0.12	0.00	+0.11	+0.81	+4.2	+3.7
16	Prague	λ Virginis	IB	−0.75	+0.81	+0.55	−0.08	−0.56	+0.18	−0.22	+0.35	+0.77	−2.7	−2.0
16	Prague	λ Virginis	E	+0.62	−0.66	+0.72	−0.11	−0.73	+0.15	+0.15	+0.38	−0.62	+1.4	+1.1
17	Prague	ν Libræ	E	+0.78	−0.87	−0.47	+0.18	+0.51	−0.14	+0.17	−0.43	−0.85	+2.3	+1.9
Mar. 3	Strassburg	δ Tauri	I	−1.03	−0.92	−0.23	+0.20	−0.30	−0.16	+0.10	−0.25	−0.94	−0.2	+0.7
3	Strassburg	64 Tauri	I	−1.07	−0.97	+0.06	−0.05	+0.08	−0.11	+0.11	+0.10	−0.99	−0.1	+0.8
6	Greenwich	λ Geminor.	I	−0.94	−0.56	−0.06	+0.42	−0.42	−0.02	−0.13	−0.36	−0.81	0.0	+0.9
6	Prague	λ Geminor.	I	−0.85	−0.51	−0.08	+0.57	−0.58	0.00	−0.12	−0.52	−0.73	−0.1	+0.6
8	Cape	209 B. Cancri	I	−0.78	−0.13	−0.22	−0.59	+0.63	−0.20	−0.17	+0.48	−0.48	−0.9	−0.2
9	Cape	89 B. Leonis	I	−0.91	+0.05	−0.21	−0.32	+0.38	−0.16	−0.25	+0.24	−0.40	−1.3	−0.5
9	Cape	π Leonis	I	−0.91	+0.05	−0.21	−0.32	+0.38	−0.16	−0.25	+0.23	−0.40	−1.7	−0.9
15	Cape	μ Libræ	E	+0.80	−0.88	−0.43	+0.14	+0.45	−0.13	+0.20	−0.30	−0.67	+0.2	−0.2
24	Cape	κ Aquarii	E	+0.98	+0.33	−0.27	−0.29	−0.40	−0.01	−0.31	+0.11	−0.31	+3.2	+2.8
Apr. 4	Washington	α Cancri	I	−0.24	−0.07	+0.30	+0.92	−0.97	+0.22	−0.09	−0.71	−0.22	+0.2	+0.4
6	Washington	34 Sextantis	I	−0.73	+0.12	−0.46	−0.47	+0.65	−0.21	−0.20	+0.27	−0.51	−1.5	−0.9
30	Berlin	B. D. +15° 1619	I	−1.06	−0.62	0.00	−0.17	+0.17	−0.15	−0.15	+0.20	−0.92	−0.2	+0.7
30	Berlin	B. D. +15° 1620	I	−0.47	−0.28	−0.02	+0.90	−0.90	+0.09	−0.08	−0.82	−0.41	+0.1	+0.5
30	Berlin	B. D. +15° 1624	I	−1.06	−0.62	0.00	+0.11	−0.11	−0.10	−0.16	−0.06	−0.92	0.0	+0.8
30	Berlin	B. D. +15° 1633	I	−1.05	−0.62	0.00	+0.21	−0.21	−0.09	−0.16	−0.16	−0.91	+0.9	+1.7
30	Berlin	B. D. +15° 1635	I	−0.95	−0.56	0.00	−0.45	+0.45	−0.18	−0.15	+0.46	−0.83	−0.7	+0.1
30	Berlin	B. D. +15° 1642	I	−0.94	−0.55	0.00	+0.48	−0.48	−0.03	−0.16	−0.40	−0.82	+0.3	+1.1
May 1	Cape	29 Cancri	I	−0.08	−0.04	−0.21	−0.98	+1.00	−0.21	+0.02	+0.82	−0.09	−0.2	−0.1
1	Washington	A^2 Cancri	I	−0.98	−0.43	−0.07	−0.23	+0.25	−0.13	−0.23	+0.24	−0.96	0.0	+0.8
2	Berlin	ω Leonis	I	−0.85	−0.21	−0.25	−0.50	+0.56	−0.22	−0.20	+0.42	+0.83	−0.3	+0.4
8	Berlin	λ Virginis	I	−0.69	+0.70	+0.62	−0.16	−0.64	+0.29	−0.21	+0.36	−0.19	−0.3	+0.3
8	Prague	λ Virginis	I	−0.74	+0.65	+0.56	−0.13	−0.58	+0.17	−0.35	+0.36	−0.18	+1.0	+1.6
29	Berlin	B. D. +10° 1956	I	−1.03	−0.38	+0.05	+0.12	−0.13	−0.06	−0.26	−0.05	−0.86	+0.9	+1.7
30	Cape	89 B. Leonis	I	−0.53	−0.08	−0.51	−0.68	+0.85	−0.28	−0.10	+0.48	−0.50	−0.5	−0.1
30	Greenwich	16 Sextantis	I	−1.00	−0.16	+0.01	+0.01	−0.01	−0.05	−0.30	+0.01	−0.95	0.0	+0.8
June 5	Cape	μ Libræ	I	−0.62	+0.63	−0.68	+0.23	+0.73	−0.14	−0.12	−0.50	−0.40	−0.5	0.0
28	Washington	υ Leonis	I	−0.88	+0.24	−0.37	−0.18	−0.41	−0.15	−0.26	+0.19	−0.85	−0.7	0.0
28	Washington	υ Leonis	EB	+0.94	−0.25	−0.20	−0.08	+0.22	−0.05	+0.32	+0.17	+0.92	−1.4	−1.8
28	Berlin	B. D. + 0° 2793	I	−0.92	+0.25	−0.27	−0.15	+0.31	−0.12	−0.29	+0.10	−0.88	+0.4	+1.1

GROUP XII—1874–1890—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1884, July	3	Prague	32 Libræ	I	−0.38	+0.41	+0.76	−0.50	−0.91	+0.17	−0.09	+0.73	−0.33	+0.8	+1.1
	11	Strassburg	θ Aquarii	IB	−0.94	−0.02	+0.20	+0.22	+0.30	+0.05	+0.31	−0.14	+0.70	+1.8	+2.5
	15	Berlin	o Piscium	E	+1.00	+0.75	+0.41	−0.06	+0.41	+0.25	−0.23	+0.17	−0.91	−1.2	−1.6
	30	Berlin	88 B. Libræ	I	−0.76	+0.66	−0.57	+0.35	+0.66	−0.18	−0.14	−0.47	−0.15	−3.0	−2.3
Aug.	15	Strassburg	115 Tauri	E	+1.09	+0.98	+0.01	−0.03	+0.03	+0.14	−0.03	+0.02	−0.90	+3.2	+2.8
Sept.	8	Berlin	B. D.+ 9° 264	E	+1.07	+0.79	+0.19	−0.06	+0.20	+0.20	−0.25	+0.10	−0.72	+3.8	+3.4
	12	Berlin	B. D.+17° 1101	E	+1.11	+0.96	−0.03	+0.09	−0.09	+0.16	+0.01	−0.11	−0.99	+1.2	+0.8
	12	Berlin	B. D.+17° 1113	E	+0.99	+0.85	−0.13	+0.44	−0.46	+0.16	+0.02	−0.48	−0.88	−1.1	−1.5
	12	Berlin	B. D.+17° 1136	E	+0.22	+0.19	+0.27	−0.94	+0.98	0.00	0.00	+0.97	−0.20	−0.6	−0.7
	12	Berlin	B. D.+17° 1144	E	+1.00	+0.86	−0.11	+0.43	−0.44	+0.16	+0.03	−0.46	−0.89	−1.3	−1.7
	12	Berlin	B. D.+17° 1145	E	+0.59	+0.51	−0.22	+0.82	−0.85	+0.11	+0.01	−0.87	−0.52	+2.0	+1.8
	12	Berlin	B. D.+17° 1147	E	+1.11	+0.96	+0.01	−0.03	+0.03	+0.15	+0.04	0.00	−0.99	+1.2	+0.8
	12	Berlin	B. D.+17° 1151	E	+1.10	+0.95	+0.03	−0.11	+0.11	+0.15	+0.03	+0.09	−0.98	+1.1	+0.7
	12	Berlin	B. D.+17° 1158	E	+1.10	+0.95	−0.04	+0.14	−0.14	+0.16	+0.02	−0.16	−0.98	+1.2	+0.8
	12	Berlin	B. D.+17° 1161	E	+0.11	+0.96	−0.03	+0.10	−0.10	+0.16	+0.02	−0.12	−0.99	+1.1	+0.7
	12	Berlin	124 H¹. Orionis	E	+0.83	+0.72	−0.16	+0.64	−0.66	+0.14	+0.02	−0.68	−0.74	−0.3	−0.6
	13	Berlin	B. D.+16° 1380	E	+1.03	+0.83	−0.07	+0.34	−0.35	+0.18	+0.08	−0.36	−0.88	0.0	−0.4
	13	Berlin	B. D.+17° 1495	E	+0.66	+0.53	−0.17	+0.78	−0.80	+0.18	+0.07	−0.80	−0.56	−1.3	−1.6
	13	Berlin	B. D.+16° 1385	E	+1.09	+0.88	−0.03	+0.15	−0.15	+0.17	+0.10	−0.18	−0.94	+0.8	+0.4
	13	Berlin	B. D.+17° 1502	E	+0.57	+0.45	−0.18	+0.84	−0.86	+0.18	+0.05	−0.85	−0.48	+0.8	+0.6
	13	Berlin	B. D.+16° 1395	E	+1.10	+0.88	−0.01	+0.05	−0.05	+0.16	+0.11	−0.08	−0.94	+0.9	+0.5
	13	Berlin	B. D.+16° 1398	E	+0.99	+0.79	+0.09	−0.43	+0.44	+0.09	+0.11	+0.41	−0.85	+0.9	+0.5
	13	Berlin	B. D.+16° 1400	E	+1.09	+0.86	+0.04	−0.20	+0.20	+0.14	+0.11	+0.17	+0.92	−0.3	−0.7
	14	Berlin	B. D.+14° 1822	E	+0.59	+0.41	−0.17	−0.82	+0.84	−0.07	+0.11	+0.73	−0.47	+1.2	+1.0
	14	Berlin	B. D.+14° 1825	E	+0.96	+0.66	−0.10	−0.45	+0.46	+0.03	+0.18	+0.38	−0.77	+0.8	+0.4
	14	Berlin	B. D.+14° 1828	E	+1.04	+0.71	−0.06	−0.26	+0.27	+0.08	+0.18	+0.22	−0.83	−0.1	−0.5
	14	Berlin	B. D.+14° 1829	E	+1.04	+0.71	−0.06	−0.26	+0.27	+0.07	+0.19	+0.21	−0.83	+0.7	+0.3
	14	Berlin	B. D.+14° 1838	E	+0.94	+0.64	−0.11	−0.49	+0.50	+0.02	+0.18	+0.42	−0.75	+0.9	+0.5
	14	Berlin	B. D.+14° 1839	E	+0.86	+0.59	+0.13	+0.58	−0.60	+0.21	+0.14	−0.55	−0.69	−1.0	−1.4
	15	Berlin	B. D.+11° 1974	E	+0.54	+0.30	−0.38	−0.79	+0.87	−0.12	+0.15	+0.66	−0.38	+0.4	+0.2
	26	Berlin	290 B. Ophiuchi	I	−0.77	+0.84	+0.16	−0.48	−0.50	+0.05	+0.06	+0.53	−0.87	−1.4	−0.8
	28	Berlin	B. D.−17° 5672	I	−0.86	+0.70	+0.04	+0.35	+0.35	+0.08	+0.13	−0.32	−0.89	−0.8	+1.5
	28	Berlin	B. D.−17° 5699	I	−0.92	+0.74	−0.01	−0.05	−0.05	+0.02	+0.15	+0.01	−0.95	−2.6	−1.9
Oct.	9	Prague	130 Tauri	E	+1.09	+0.99	+0.01	−0.04	+0.04	+0.14	0.00	+0.03	−0.89	+0.4	0.0
	28	Cape	c¹ Capricor.	I	−0.58	+0.17	+0.52	+0.60	+0.80	+0.19	+0.20	−0.42	−0.55	−1.4	−1.0
	28	Cape	c¹ Capricor.	EB	+0.30	−0.09	+0.63	+0.71	+0.95	+0.26	−0.03	−0.59	+0.29	−3.1	−3.2
	30	Berlin	11 Piscium	I	−0.99	−0.19	−0.24	−0.10	−0.26	−0.15	+0.28	+0.05	−0.63	−1.0	−0.3
Nov.	22	Berlin	B. D.−17° 5748	I	−0.36	+0.29	+0.19	+0.90	+0.92	+0.13	+0.06	−0.85	−0.34	−0.3	−0.1
	25	Prague	θ Aquarii	I	−0.94	+0.20	−0.18	−0.15	−0.23	−0.08	+0.27	+0.11	−0.97	−0.8	−0.1
	29	Cape	54 Ceti	I	−0.46	−0.27	−0.89	+0.19	−0.91	−0.31	+0.07	−0.41	−0.26	−0.3	0.0
Dec.	1	Cape	148 B. Tauri	I	−1.15	−0.93	+0.04	−0.03	+0.05	−0.21	+0.16	+0.08	−0.18	−1.7	−0.9
	30	Greenwich	115 Tauri	I	−1.11	−0.96	−0.09	+0.26	−0.28	−0.21	+0.04	−0.27	−0.32	−0.7	+0.1
1885, Jan.	4	Cape	48 Leonis	E	+1.01	+0.50	+0.24	+0.15	−0.28	+0.19	+0.27	−0.15	−0.60	−0.2	−0.5
	20	Berlin	B. D.− 3° 5639	I	−1.00	−0.04	+0.11	+0.04	+0.12	−0.01	+0.32	−0.02	−0.82	−0.5	+0.2
	20	Berlin	B. D.− 3° 5642	I	−1.00	−0.04	−0.15	−0.05	−0.16	−0.11	+0.31	+0.02	−0.82	−2.1	−1.4
	20	Berlin	B. D.− 3° 5643	I	−0.99	−0.04	+0.17	−0.06	−0.18	−0.11	+0.31	+0.03	−0.81	−1.8	−1.1
	20	Berlin	B. D.− 3° 5644	I	−0.73	−0.04	+0.66	+0.22	+0.70	+0.17	+0.26	−0.12	−0.60	+0.7	+1.2
	21	Berlin	98 B. Piscium	I	−0.99	−0.04	−0.19	−0.02	−0.19	−0.11	+0.30	−0.01	−0.81	−2.8	−2.1
	22	Berlin	e Piscium	I	−1.03	−0.43	+0.19	−0.03	+0.19	−0.04	+0.30	+0.05	−0.97	+1.0	+1.7
	22	Prague	e Piscium	I	−0.95	−0.42	+0.32	−0.05	+0.33	+0.05	+0.27	−0.14	−0.94	−0.7	0.0
	22	Strassburg	e Piscium	I	−0.96	−0.42	+0.31	−0.05	+0.32	+0.04	+0.29	+0.08	−0.94	−0.1	+0.6
	22	Strassburg	e Piscium	EB	+0.88	+0.39	+0.47	−0.08	+0.48	+0.18	−0.34	+0.14	+0.87	+0.9	+0.6
	23	Berlin	B. D.+ 8° 307	I	−0.98	−0.61	+0.35	−0.16	+0.39	0.00	+0.26	+0.20	−0.92	−0.5	+0.2
	23	Berlin	B. D.+ 8° 314	I	−1.05	−0.65	+0.19	−0.08	+0.21	−0.07	+0.27	+0.11	−0.98	+2.3	+3.0
	23	Berlin	B. D.+ 9° 264	I	−0.59	−0.36	−0.76	+0.34	−0.84	−0.29	+0.12	−0.44	−0.55	−1.9	−1.5
	23	Berlin	B. D.+ 9° 266	I	−0.86	−0.53	−0.55	+0.25	−0.60	−0.27	+0.20	−0.32	−0.80	−0.4	+0.2
	24	Berlin	B. D.+12° 411	I	−1.09	−0.81	−0.07	+0.05	−0.09	−0.15	+0.21	−0.04	−0.96	−3.1	−2.4
	24	Berlin	B. D.+12° 410	I	−0.46	−0.34	−0.73	+0.55	−0.91	−0.26	+0.08	−0.64	−0.40	−1.1	−0.8
	25	Berlin	B. D.+15° 546	I	−1.09	−0.81	−0.01	+0.01	−0.01	−0.13	+0.16	−0.01	−0.96	−2.4	−1.7
	25	Berlin	B. D.+15° 547	I	−1.06	−0.79	+0.16	−0.20	+0.25	−0.09	+0.16	+0.23	−0.93	+0.8	+1.5
	25	Berlin	B. D.+15° 557	I	−0.83	−0.62	+0.39	−0.52	+0.65	0.00	+0.13	+0.57	−0.73	−1.0	−0.4
	26	Berlin	318 B. Tauri	I	−0.52	−0.46	+0.34	−0.81	+0.88	−0.01	+0.03	+0.87	−0.36	−2.2	−1.8
	28	Strassburg	λ Geminor.	I	−1.12	−0.92	+0.03	+0.17	−0.17	−0.16	−0.10	−0.15	−0.44	−1.3	−0.5
Feb.	1	Berlin	d Leonis	E	+1.04	+0.36	+0.01	0.00	−0.01	+0.09	+0.29	+0.07	−0.38	+0.9	+0.6
	20	Greenwich	38 Arietis	I	−0.32	−0.22	−0.77	+0.55	−0.95	−0.25	+0.05	−0.62	−0.29	−1.0	−0.8
	21	Berlin	B. D.+14° 592	E	+0.20	+0.16	+0.63	−0.76	+0.99	+0.20	−0.01	+0.82	+0.18	−3.7	−3.8
	21	Berlin	B. D.+14° 595	I	−1.05	−0.84	+0.19	−0.23	+0.30	−0.09	+0.18	+0.26	−0.95	+1.2	+1.9
	21	Berlin	B. D.+14° 597	I	−1.07	−0.85	+0.16	−0.20	+0.26	−0.11	+0.18	+0.22	−0.97	+1.6	+2.3
	21	Berlin	B. D.+14° 598	I	−0.73	−0.58	+0.48	−0.58	+0.76	+0.02	+0.14	+0.64	−0.66	−0.2	+0.3
	21	Berlin	B. D.+14° 600	I	−1.10	−0.88	−0.02	+0.02	−0.03	−0.15	+0.17	−0.01	−1.00	−3.3	−2.6

GROUP XII—1874–1890—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
														$''$	$''$
1885, Feb.	22	Berlin	α Tauri	I	−0.42	−0.36	+0.41	−0.82	+0.92	+0.05	+0.05	+0.86	−0.38	+0.6	+0.9
	22	Berlin	α Tauri	EB	+0.38	+0.33	+0.42	−0.83	+0.94	+0.12	−0.04	+0.88	+0.34	+1.2	+1.1
	23	Greenwich	130 Tauri	I	−1.05	−0.97	−0.05	+0.24	−0.25	−0.14	+0.02	−0.25	−0.89	−2.1	−1.4
	23	Strassburg	130 Tauri	I	−1.06	−0.97	−0.04	+0.22	−0.22	−0.14	+0.01	−0.22	−0.89	−2.8	−2.1
	24	Berlin	B. D. +17° 1339	I	−0.95	−0.84	+0.01	+0.52	−0.52	−0.11	−0.06	−0.50	−0.72	−1.2	−0.5
	24	Berlin	B. D. +17° 1392	I	−1.11	−0.98	0.00	−0.05	+0.05	−0.07	−0.07	−0.07	−0.84	−2.4	−1.7
	24	Berlin	B. D. +17° 1393	I	−0.78	−0.68	−0.04	−0.71	+0.71	−0.15	−0.05	+0.71	−0.59	−2.4	−1.9
Mar.	4	Cape	κ Virginis	E	+0.92	−0.45	+0.26	−0.14	−0.30	+0.10	+0.23	+0.20	−0.67	+2.2	+2.0
	21	Berlin	B. D. +15° 630	I	−0.97	−0.81	+0.22	−0.42	+0.47	−0.08	+0.13	+0.44	−0.83	+0.1	+0.7
	21	Berlin	75 Tauri	I	−1.06	−0.88	+0.12	−0.24	+0.27	−0.11	+0.13	+0.25	−0.90	+1.5	+2.1
	21	Berlin	B. D. +15° 633	I	−0.28	−0.23	+0.43	−0.87	+0.97	+0.07	+0.03	+0.90	−0.24	+0.7	+0.9
	21	Berlin	264 B. Tauri	I	−0.46	−0.39	+0.40	−0.82	+0.91	−0.05	+0.06	+0.86	−0.39	−1.0	−0.7
	22	Berlin	B. D. +17° 918	I	−0.94	−0.83	−0.13	+0.51	−0.53	−0.16	+0.04	−0.52	−0.84	−0.3	+0.3
	22	Berlin	B. D. +17° 919	I	−1.01	−0.89	+0.10	−0.40	+0.41	−0.12	+0.07	+0.39	−0.90	−0.5	+0.1
	22	Berlin	111 Tauri	I	−1.01	−0.89	+0.10	−0.40	+0.41	−0.12	+0.07	+0.39	−0.90	−1.0	−0.4
	22	Berlin	B. D. +17° 921	I	−0.88	−0.77	−0.15	+0.61	−0.62	−0.16	+0.04	−0.60	−0.78	+0.4	+0.9
	22	Berlin	B. D. +17° 929	I	−0.75	−0.67	+0.16	−0.71	+0.73	−0.05	+0.03	+0.72	−0.67	−0.7	−0.2
	22	Berlin	117 Tauri	I	−0.64	−0.57	+0.18	−0.79	+0.81	−0.05	+0.03	+0.81	−0.57	−0.9	−0.5
	22	Berlin	B. D. +17° 943	I	−1.02	−0.90	+0.08	−0.39	+0.40	−0.13	+0.06	+0.40	−0.91	+0.4	+1.0
	22	Berlin	B. D. +17° 945	I	−1.05	−0.89	+0.08	+0.40	−0.41	−0.16	+0.05	−0.40	−0.90	−1.1	−0.6
	22	Berlin	B. D. +17° 950	I	−1.07	−0.94	−0.05	+0.26	−0.27	−0.15	+0.02	−0.26	−0.95	−1.0	−0.4
	22	Prague	111 Tauri	I	−0.92	−0.85	+0.13	−0.49	+0.50	−0.08	+0.03	+0.50	−0.86	−0.5	+0.1
	22	Greenwich	111 Tauri	I	−0.91	−0.83	+0.14	+0.51	+0.53	−0.07	+0.05	+0.51	−0.84	−1.4	−0.9
	22	Greenwich	117 Tauri	I	−0.26	−0.24	+0.23	−0.94	+0.97	+0.01	+0.01	+0.96	−0.24	−0.8	−0.6
	23	Berlin	B. D. +17° 1225	I	−1.05	−0.95	0.00	−0.32	+0.32	−0.16	−0.01	+0.33	−0.95	+0.4	+1.0
	23	Berlin	B. D. +17° 1226	I	−0.83	−0.75	0.00	+0.66	−0.66	−0.09	−0.03	−0.65	−0.75	−1.3	−0.8
	23	Berlin	B. D. +17° 1230	I	−0.88	−0.79	0.00	−0.61	+0.61	−0.14	−0.02	+0.62	−0.79	−0.9	−0.4
	23	Berlin	B. D. +17° 1231	I	−0.87	−0.78	0.00	−0.62	+0.62	−0.13	−0.02	+0.63	−0.78	−2.7	−2.2
	23	Berlin	B. D. +17° 1238	I	−0.99	−0.89	0.00	−0.46	+0.46	−0.16	−0.02	+0.47	−0.89	−1.7	−1.1
	23	Berlin	B. D. +17° 1241	I	−0.69	−0.62	0.00	−0.78	+0.78	−0.12	−0.02	+0.78	−0.62	−0.8	−0.4
	23	Berlin	B. D. +17° 1247	I	−1.08	−0.97	0.00	+0.23	−0.23	−0.14	−0.04	−0.22	−0.97	0.0	+0.6
	23	Berlin	B. D. +17° 1252	I	−1.11	−1.00	0.00	−0.08	+0.08	−0.16	−0.02	+0.09	−1.00	−1.2	−0.6
	23	Berlin	B. D. +17° 1256	I	−0.94	+0.34	−0.01	−0.34	+0.34	−0.06	−0.02	+0.35	−0.94	−0.6	0.0
	23	Berlin	B. D. +17° 1261	I	−0.81	−0.73	+0.01	+0.67	−0.67	−0.08	−0.03	+0.67	−0.73	−1.4	−0.9
	23	Berlin	B. D. +17° 1263	I	−0.61	−0.55	−0.02	−0.84	+0.84	−0.12	−0.01	+0.84	−0.55	−1.5	−1.1
	23	Berlin	B. D. +17° 1277	I	−0.83	−0.75	+0.01	+0.66	−0.66	−0.09	+0.04	−0.65	−0.75	−1.3	−0.8
	23	Berlin	B. D. +17° 1280	I	−1.03	−0.93	−0.01	−0.37	+0.37	−0.16	−0.03	+0.38	−0.93	+0.3	+0.9
	23	Berlin	B. D. +17° 1281	I	−0.92	−0.83	−0.01	−0.55	+0.55	−0.15	−0.03	+0.56	−0.83	−1.4	−0.9
	23	Berlin	B. D. +17° 1288	I	−0.87	−0.78	−0.02	−0.62	+0.62	−0.15	+0.04	+0.62	−0.78	−1.0	−0.5
	23	Berlin	B. D. +17° 1291	I	−0.60	−0.54	−0.03	−0.84	+0.84	−0.12	−0.02	+0.84	−0.54	−1.4	−1.0
	23	Berlin	B. D. +17° 1294	I	−0.98	−0.88	−0.02	−0.47	−0.47	−0.49	+0.38	+0.48	−0.88	−1.1	−0.5
	23	Berlin	B. D. +17° 1307	I	−1.03	−0.93	+0.01	+0.37	−0.37	−0.14	−0.05	−0.37	−0.93	−0.2	+0.4
	27	Greenwich	43 Leonis	I	−0.85	−0.45	+0.51	+0.31	−0.60	+0.08	−0.26	−0.25	−0.47	−1.3	−0.8
	28	Greenwich	75 Leonis	I	−1.00	−0.35	−0.25	−0.08	+0.26	−0.16	−0.29	+0.08	−0.40	−1.1	−0.5
Apr.	2	Cape	γ Libræ	IB	−0.78	+0.60	+0.36	−0.42	−0.55	+0.10	−0.17	+0.39	+0.51	−1.5	−1.0
	2	Cape	γ Libræ	E	+0.72	−0.55	+0.41	−0.49	−0.64	+0.11	+0.12	+0.57	−0.48	+0.8	+0.6
	4	Cape	125 B. Ophiuchi	E	+0.41	−0.42	−0.29	+0.85	+0.89	−0.08	+0.04	−0.87	−0.39	−0.5	−0.6
	18	Berlin	B. D. +17° 862	I	−0.86	−0.74	−0.18	+0.60	−0.62	−0.17	+0.05	−0.60	−0.59	+0.5	+1.0
	19	Berlin	B. D. +17° 1136	I	−0.80	+0.24	+0.03	−0.57	+0.57	−0.02	−0.01	+0.58	−0.74	−2.0	−1.5
	19	Berlin	B. D. +17° 1139	I	−0.76	+0.23	+0.03	−0.63	+0.63	−0.02	0.00	+0.63	−0.70	−3.5	−3.1
	19	Berlin	B. D. +17° 1146	I	−0.95	+0.28	−0.01	+0.20	−0.20	−0.02	−0.02	−0.19	−0.88	−2.3	−1.8
	19	Berlin	B. D. +17° 1147	I	−0.74	+0.22	−0.03	+0.65	−0.65	0.00	−0.01	−0.64	−0.68	−2.2	−1.8
	19	Berlin	B. D. +17° 1151	I	−0.77	+0.23	−0.02	+0.61	−0.61	0.00	−0.01	−0.60	−0.71	−1.4	−1.0
	19	Berlin	B. D. +17° 1153	I	−0.50	+0.15	+0.03	−0.86	+0.86	−0.02	−0.00	+0.86	−0.47	−1.4	−1.1
	19	Berlin	B. D. +17° 1154	I	−0.86	+0.26	+0.02	−0.45	+0.45	−0.02	−0.01	+0.46	−0.80	−1.9	−1.4
	19	Berlin	B. D. +17° 1154	I	−0.86	+0.26	+0.02	−0.45	+0.45	−0.02	−0.01	+0.46	−0.80	−2.8	−2.3
	19	Berlin	B. D. +17° 1155	I	−0.89	+0.27	+0.01	−0.38	+0.38	0.02	−0.02	+0.38	−0.83	−2.0	−1.5
	19	Berlin	B. D. +17° 1167	I	−0.96	+0.29	0.00	+0.14	−0.14	−0.02	−0.02	−0.14	−0.89	−1.9	−1.3
	19	Berlin	B. D. +17° 1172	I	−0.87	+0.26	+0.01	−0.43	+0.43	−0.02	−0.01	+0.43	−0.81	−1.2	−0.7
	19	Berlin	B. D. +17° 1177	I	−0.91	+0.27	−0.01	+0.34	−0.34	−0.01	−0.01	−0.34	−0.85	−2.4	−1.9
	19	Berlin	B. D. +17° 1179	I	−0.95	+0.28	0.00	−0.20	+0.20	−0.02	0.00	+0.20	−0.88	−2.0	−1.4
	19	Berlin	B. D. +17° 1183	I	−0.97	+0.29	0.00	−0.04	+0.04	−0.02	−0.01	+0.04	−0.90	−2.0	−1.4
	19	Berlin	B. D. +17° 1191	I	−0.68	+0.20	+0.01	−0.71	+0.71	−0.02	−0.01	+0.72	−0.63	−2.8	−2.4
	20	Berlin	B. D. +17° 1506	I	−0.65	−0.58	+0.17	+0.79	−0.81	−0.03	−0.06	−0.79	−0.58	0.0	+0.4
	20	Berlin	B. D. +16° 1400	I	−1.02	−0.90	−0.09	−0.40	+0.41	−0.18	−0.07	+0.40	−0.91	+1.1	+1.7
	20	Berlin	B. D. +16° 1419	I	−0.99	−0.87	+0.10	+0.45	−0.46	−0.11	−0.10	−0.43	−0.88	+2.7	+3.2
	20	Berlin	B. D. +16° 1421	I	−1.01	−0.89	+0.09	+0.40	−0.41	−0.11	−0.11	−0.37	−0.90	+0.8	+1.3
	20	Berlin	B. D. +16° 1423	I	−0.81	−0.72	+0.15	+0.66	−0.68	−0.05	−0.08	−0.65	−0.72	−0.1	+0.4
	20	Greenwich	λ Geminor.	I	−0.51	−0.46	+0.21	+0.85	−0.88	+0.02	−0.05	−0.85	−0.46	−0.1	+0.2
	20	Greenwich	λ Geminor.	EB	+0.34	+0.30	+0.23	+0.92	−0.95	+0.14	+0.03	+0.95	+0.30	+0.4	+0.3

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													"	"
1885, Apr. 21	Berlin	30 B. Cancri	I	−0.96	−0.81	+0.21	+0.45	−0.49	−0.06	−0.16	−0.43	−0.87	+0.4	+0.9
22	Berlin	209 B. Cancri	I	−0.83	−0.62	+0.43	+0.51	−0.66	+0.04	−0.19	−0.47	−0.75	+0.3	+0.7
24	Prague	*d* Leonis	I	−0.67	−0.30	+0.71	+0.26	−0.75	+0.19	−0.22	−0.42	−0.54	+0.5	+0.9
26	Berlin	71 G. Virginis	I	−0.88	−0.05	+0.49	−0.05	−0.49	+0.10	−0.29	+0.09	−0.45	+0.2	+0.7
May 5	Cape	16 B. Capricor.	E	+0.54	−0.53	+0.40	+0.69	+0.80	+0.11	−0.08	−0.73	−0.59	−0.7	−0.8
5	Cape	β Capricor.	E	+0.48	−0.47	+0.42	+0.73	+0.85	+0.12	−0.06	−0.77	−0.52	−1.1	−1.2
19	Berlin	B. D. +12° 1931	I	−0.98	−0.79	−0.28	−0.36	+0.45	−0.23	−0.17	+0.37	−0.83	+2.2	+2.7
19	Berlin	B. D. +12° 1942	I	−0.74	−0.60	+0.47	+0.57	−0.73	+0.06	−0.16	−0.57	−0.62	+0.8	+1.2
19	Berlin	α Cancri	I	−0.63	−0.51	−0.52	−0.64	+0.82	−0.27	−0.11	+0.64	−0.53	−1.2	−0.9
22	Cape	τ Leonis	I	−0.89	−0.42	−0.31	−0.07	+0.31	−0.09	−0.28	+0.06	−0.92	+1.7	+2.2
24	Cape	θ Virginis	I	−0.95	0.00	−0.22	+0.06	+0.23	−0.10	−0.28	−0.09	−0.94	+0.2	+0.7
June 23	Cape	γ Libræ	I	−0.80	+0.53	+0.29	−0.40	−0.49	+0.11	−0.18	+0.32	−0.85	+0.1	+0.5
25	Cape	125 B. Ophiuchi	I	−0.90	+0.88	+0.03	−0.11	−0.11	+0.04	−0.08	+0.12	−0.35	−0.2	+0.3
25	Cape	164 B. Ophiuchi	I	−0.77	+0.75	+0.10	−0.52	−0.53	+0.06	−0.06	+0.52	−0.30	+0.7	+1.1
28	Cape	54 Sagittarii	E	+0.56	−0.61	−0.30	−0.72	−0.78	−0.12	−0.09	+0.74	−0.16	+0.1	0.0
July 1	Cape	θ Aquarii	E	+0.84	−0.55	+0.36	+0.19	+0.40	+0.09	−0.24	−0.25	−0.76	−2.1	−2.2
6	Berlin	B. D. + 9° 296	E	+1.00	+0.40	−0.25	+0.19	−0.31	+0.02	−0.27	−0.18	−0.86	+0.1	−0.1
6	Berlin	B. D. + 9° 301	E	+1.05	+0.42	+0.04	+0.03	−0.05	+0.09	−0.26	−0.01	−0.91	+0.8	+0.6
7	Berlin	B. D. +12° 453	E	+1.03	+0.59	+0.18	−0.21	+0.28	+0.18	−0.20	+0.21	−0.78	+0.5	+0.3
9	Berlin	α Tauri	IB	−0.90	−0.74	+0.19	−0.54	+0.57	−0.05	+0.10	+0.53	+0.40	−1.7	−1.2
21	Berlin	B. D. −16° 4230	I	−0.91	+0.64	+0.08	−0.18	−0.19	+0.05	−0.16	+0.17	−0.88	+1.2	+1.7
22	Berlin	29 Ophiuchi	I	−0.10	+0.09	−0.22	+0.96	+0.99	0.00	−0.01	−0.96	−0.08	+1.6	+1.7
22	Greenwich	29 Ophiuchi	I	−0.33	+0.30	−0.22	+0.90	+0.93	−0.06	−0.03	−0.90	−0.28	−0.4	−0.2
26	Cape	β Capricor.	IB	−0.57	+0.60	−0.43	−0.64	−0.77	−0.10	+0.09	+0.65	−0.02	+1.6	+1.9
26	Cape	β Capricor.	E	+0.74	−0.78	−0.33	−0.48	−0.58	−0.12	−0.15	+0.50	+0.02	−0.3	−0.4
Aug. 20	Greenwich	95 B. Sagittarii	I	−0.63	+0.68	+0.11	+0.70	−0.71	+0.02	+0.02	+0.71	−0.57	+0.7	+1.0
31	Berlin	B. D. +13° 565	E	+1.01	+0.56	+0.18	−0.28	+0.33	+0.17	−0.17	+0.28	−0.92	−1.1	−1.2
31	Berlin	B. D. +13° 568	E	+1.05	+0.58	+0.06	−0.09	−0.11	+0.13	−0.20	+0.11	−0.96	+1.8	+1.7
Sept. 1	Berlin	θ^1 Tauri	E	+1.08	+0.77	−0.03	+0.10	−0.11	+0.12	−0.13	−0.09	−0.99	+0.3	+0.2
1	Berlin	θ^2 Tauri	E	+1.06	+0.76	+0.07	−0.22	+0.23	+0.09	−0.13	+0.23	−0.97	−1.0	−1.1
1	Berlin	B. D. +15° 633	E	+0.65	+0.47	−0.25	+0.76	−0.80	−0.03	−0.09	−0.73	−0.60	+0.3	+0.2
1	Berlin	B. D. +15° 635	E	+0.85	+0.61	−0.20	+0.60	−0.63	+0.03	−0.11	−0.59	−0.78	−1.0	−1.1
1	Berlin	269 B. Tauri	E	+0.99	+0.71	−0.13	+0.39	−0.41	+0.06	−0.14	−0.37	−0.91	−0.9	−1.0
1	Berlin	85 Tauri	E	+0.58	+0.41	+0.26	−0.81	+0.85	+0.19	−0.07	+0.80	−0.53	+1.3	+1.2
1	Berlin	B. D. +15° 646	E	+0.95	+0.68	+0.15	−0.48	+0.50	+0.19	−0.11	+0.48	−0.87	+0.3	+0.2
1	Berlin	B. D. +15° 648	E	+0.71	+0.51	+0.23	−0.73	+0.76	+0.19	−0.07	+0.72	−0.65	+0.8	+0.7
1	Berlin	B. D. +15° 649	E	+0.68	+0.48	+0.23	−0.76	+0.79	+0.19	−0.08	+0.74	−0.62	+0.8	+0.7
1	Berlin	275 B. Tauri	E	+0.94	+0.67	−0.15	+0.49	−0.51	+0.05	−0.13	−0.46	−0.86	−0.3	−0.4
1	Berlin	α Tauri	IB	−0.49	−0.35	−0.26	+0.85	−0.89	−0.18	+0.06	−0.84	+0.45	−0.3	0.0
1	Berlin	B. D. +15° 653	E	+0.65	+0.47	−0.23	+0.77	−0.80	+0.02	−0.09	−0.74	−0.60	+2.2	+2.1
1	Berlin	α Tauri	E	+0.94	+0.67	+0.15	−0.48	+0.50	+0.18	−0.12	+0.47	−0.87	−1.3	−1.4
1	Greenwich	θ^2 Tauri	E	+1.04	+0.77	+0.04	−0.12	+0.13	+0.12	−0.14	+0.12	−0.99	+1.1	+1.0
1	Greenwich	264 B. Tauri	E	+0.69	+0.51	+0.26	−0.71	+0.76	−0.03	−0.10	−0.68	−0.65	−1.4	−1.5
1	Greenwich	85 Tauri	E	+0.71	+0.52	+0.24	−0.70	+0.74	+0.16	−0.08	+0.69	−0.57	+0.7	+0.6
1	Prague	α Tauri	IB	−0.63	−0.46	−0.26	+0.76	−0.80	−0.17	+0.07	−0.76	+0.59	−1.1	−0.8
1	Prague	α Tauri	E	+0.78	+0.58	−0.21	+0.64	−0.67	−0.01	−0.10	−0.62	−0.74	−0.6	−0.7
2	Berlin	B. D. +17° 930	E	+1.08	+0.87	−0.02	+0.17	−0.17	+0.13	−0.07	−0.15	−0.95	+0.9	+0.8
2	Berlin	B. D. +16° 788	E	+0.70	+0.57	+0.05	−0.77	+0.77	+0.13	+0.03	−0.77	−0.62	−0.6	−0.7
2	Berlin	B. D. +17° 938	E	+1.01	+0.82	−0.03	+0.38	−0.38	+0.11	−0.06	−0.37	−0.89	−0.8	−0.9
2	Berlin	B. D. +17° 942	E	+0.83	+0.67	+0.05	−0.67	+0.67	+0.15	−0.04	+0.66	−0.73	+1.2	+1.1
2	Berlin	167 H[1]. Tauri	E	+0.43	+0.35	+0.06	−0.92	+0.92	+0.12	−0.03	+0.91	−0.38	−0.5	−0.5
2	Berlin	B. D. +17° 943	E	+1.10	+0.89	0.00	+0.05	−0.05	+0.14	−0.05	−0.05	−0.97	+1.8	+1.7
2	Berlin	B. D. +17° 945	E	+0.63	+0.51	−0.06	+0.82	−0.82	+0.04	−0.03	−0.80	−0.55	+0.1	0.0
2	Berlin	B. D. +17° 950	E	+0.99	+0.80	−0.02	+0.44	−0.44	+0.12	−0.04	−0.44	−0.87	−0.9	−1.0
2	Berlin	B. D. +17° 953	E	+0.52	+0.42	+0.04	−0.88	+0.88	+0.11	−0.02	+0.88	−0.46	−0.2	−0.3
5	Berlin	B. D. +14° 1932	E	+0.72	+0.64	+0.48	+0.59	−0.76	+0.25	+0.01	−0.62	−0.43	−0.8	−0.9
5	Berlin	B. D. +14° 1929	E	+1.10	+0.97	−0.07	−0.09	+0.11	+0.15	+0.19	+0.10	−0.65	+0.5	+0.4
5	Berlin	B. D. +14° 1930	E	+1.10	+0.97	−0.08	−0.10	+0.13	+0.15	+0.18	+0.11	−0.65	−0.3	−0.4
16	Berlin	B. D. −18° 4789	I	−1.10	−0.97	−0.01	−0.10	−0.10	−0.05	+0.01	+0.10	+0.65	−0.6	0.0
17	Berlin	B. D. −18° 5134	I	−0.74	+0.81	+0.16	+0.54	+0.56	+0.08	+0.05	−0.56	−0.81	−2.5	−2.1
17	Berlin	B. D. −18° 5136	I	−0.63	+0.69	+0.20	+0.67	+0.70	+0.08	−0.02	−0.70	−0.69	−0.5	−0.2
17	Berlin	B. D. −18° 5155	I	−0.80	+0.87	+0.13	+0.42	+0.44	+0.07	+0.06	−0.44	−0.87	−0.8	−0.4
17	Berlin	B. D. −18° 5157	I	−0.89	+0.97	−0.01	−0.04	−0.04	+0.06	+0.06	+0.02	−0.97	−0.9	−0.4
20	Berlin	18 Aquarii	I	−0.74	+0.74	+0.45	+0.38	+0.58	+0.15	+0.17	−0.02	−0.53	−2.2	−1.8
20	Greenwich	18 Aquarii	I	−0.78	+0.76	+0.41	+0.32	+0.52	+0.15	+0.22	−0.37	−0.55	−2.4	−2.0
21	Greenwich	150 B. Aquarii	I	−0.81	+0.67	−0.45	−0.20	−0.49	−0.12	+0.22	+0.22	−0.41	−0.7	−0.3
30	Berlin	B. D. +17° 1195	E	+1.05	+0.87	−0.05	−0.31	+0.31	+0.15	+0.02	−0.33	−0.94	+0.5	+0.4
30	Berlin	292 B. Orionis	E	+0.73	+0.61	+0.13	+0.74	−0.75	+0.11	+0.01	+0.74	−0.65	−0.1	−0.2
30	Berlin	B. D. +17° 1223	E	+0.48	+0.40	+0.15	+0.88	−0.90	+0.06	0.00	+0.89	−0.44	+1.4	+1.3
30	Berlin	B. D. +17° 1224	E	+1.10	+0.92	+0.01	+0.04	−0.04	+0.14	+0.01	+0.03	−0.99	−3.2	−3.3

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1885, Sept. 30	Berlin	B. D. +17° 1226	E	+1.03	+0.86	+0.06	+0.33	−0.34	+0.14	−0.01	+0.34	−0.93	−1.7	−1.8
Oct. 1	Greenwich	λ Geminor.	IB	−1.04	−0.95	−0.06	−0.26	+0.27	−0.15	−0.08	+0.27	+0.95	−1.5	−1.0
14	Berlin	B. D. −18° 5012	I	−0.82	+0.86	−0.09	−0.41	−0.42	+0.03	+0.08	+0.41	+0.87	−1.6	−1.2
16	Berlin	B. D. −16° 5545	I	−0.89	+0.99	+0.05	+0.07	+0.09	+0.07	+0.17	−0.09	−0.99	−0.9	−0.5
Nov. 17	Greenwich	80 B. Piscium	I	−0.82	+0.34	−0.53	+0.07	−0.54	−0.19	+0.24	−0.01	−0.65	−0.6	−0.2
22	Hamburg	α Tauri	IB	−1.09	−0.63	−0.03	+0.13	−0.13	−0.16	+0.14	−0.13	+0.16	−0.2	+0.3
Dec. 2	Prague	κ Virginis	IB	−0.27	−0.03	+0.73	−0.63	−0.96	+0.25	−0.11	+0.05	+0.21	+0.3	+0.4
2	Prague	κ Virginis	E	+0.07	0.00	+0.76	−0.65	−1.00	+0.28	−0.02	+0.05	−0.71	+1.1	+1.1
28	Greenwich	θ Virginis	E	+0.90	+0.38	+0.40	−0.19	−0.44	+0.18	+0.26	+0.14	−0.90	+0.9	+0.9
1886, Jan. 14	Greenwich	85 Ceti	I	−0.86	−0.18	+0.33	−0.41	+0.52	+0.08	+0.24	+0.30	−0.78	−0.2	+0.1
14	Cape	38 Arietis	I	−1.01	−0.21	−0.01	+0.01	−0.01	−0.07	+0.26	−0.05	−0.92	−2.3	−1.9
16	Greenwich	θ^2 Tauri	EB	+0.98	+0.56	+0.09	−0.40	+0.41	+0.17	−0.13	+0.39	+0.61	−2.4	−2.4
16	Greenwich	θ^1 Tauri	EB	+1.08	+0.62	+0.02	−0.07	+0.07	+0.15	−0.14	+0.08	+0.67	−1.5	−1.5
16	Greenwich	264 B. Tauri	I	−0.91	−0.53	−0.12	+0.51	−0.53	−0.18	+0.12	−0.51	−0.57	−0.4	0.0
16	Greenwich	α Tauri	I	−0.85	−0.48	−0.12	+0.61	−0.62	−0.19	+0.10	−0.59	−0.52	−1.2	−0.9
16	Greenwich	α Tauri	EB	+0.92	+0.53	−0.09	+0.51	−0.52	+0.04	−0.12	−0.46	+0.57	+0.8	+0.8
16	Hamburg	α Tauri	I	−0.84	−0.48	−0.12	+0.62	−0.63	−0.19	+0.10	−0.60	−0.52	−1.8	−1.5
16	Hamburg	α Tauri	EB	+0.88	+0.51	−0.10	+0.57	−0.58	+0.03	−0.12	−0.53	+0.55	+1.5	+1.5
18	Greenwich	26 Geminor.	I	−1.14	−0.88	−0.09	−0.24	+0.26	−0.23	−0.03	+0.24	−0.28	−1.2	−0.8
Feb. 9	Cape	122 G. Piscium	I	−0.41	+0.06	−0.73	+0.53	−0.90	−0.27	+0.09	−0.37	−0.39	−0.4	−0.3
12	Prague	γ Tauri	I	−1.03	−0.51	+0.03	−0.11	+0.12	−0.07	+0.16	+0.08	−0.95	−0.5	−0.1
13	Cape	m Tauri	I	−0.35	−0.22	−0.03	+0.94	−0.94	−0.13	+0.02	−0.89	−0.29	−0.7	−0.6
14	Cape	71 Orionis	I	−1.05	−0.83	+0.07	+0.27	−0.28	−0.15	+0.01	−0.26	−0.84	−2.9	−2.5
Mar. 9	Greenwich	ξ^1 Ceti	I	−0.94	+0.05	−0.17	+0.18	−0.24	−0.09	+0.28	−0.16	−0.76	+0.5	+0.9
9	Greenwich	64 Ceti	EB	+0.91	−0.05	+0.23	−0.25	+0.34	+0.11	−0.25	+0.22	+0.73	−2.3	−2.3
Apr. 8	Strassburg	α Tauri	I	−0.79	−0.37	−0.07	+0.63	−0.63	−0.14	+0.11	−0.60	−0.66	−1.3	−1.0
8	Strassburg	α Tauri	EB	+0.75	+0.34	−0.07	+0.68	−0.68	−0.04	−0.11	−0.62	+0.61	−0.5	−0.4
8	Pola	α Tauri	I	−0.91	−0.42	−0.05	+0.45	−0.45	−0.12	+0.12	−0.44	−0.74	−0.1	+0.2
8	Pola	α Tauri	EB	+0.86	+0.39	−0.05	+0.54	−0.54	−0.01	−0.13	−0.50	+0.70	−0.1	0.0
10	Greenwich	26 Geminor.	I	−0.98	−0.75	+0.18	+0.41	−0.46	−0.05	−0.27	−0.25	−0.89	−0.8	−0.5
14	Strassburg	48 Leonis	I	−0.64	−0.53	−0.80	−0.12	+0.81	−0.31	−0.13	+0.34	−0.42	−1.1	−1.1
15	Greenwich	τ Leonis	I	−0.41	−0.31	−0.93	+0.08	+0.93	−0.34	−0.07	+0.10	−0.22	0.0	+0.1
May 6	Greenwich	111 Tauri	I	−0.98	−0.53	−0.04	−0.37	+0.37	−0.07	+0.08	−0.31	−0.58	+2.4	+2.7
14	Cape	46 Virginis	I	−1.05	−0.63	−0.08	+0.05	+0.09	−0.15	−0.31	−0.05	−0.67	+0.6	+0.9
16	Cape	ξ Libræ	I	−1.01	−0.17	−0.08	+0.14	+0.16	−0.12	−0.24	−0.16	−0.27	−0.1	+0.2
21	Cape	ρ Sagittarii	IB	−0.80	+0.71	+0.29	+0.42	+0.51	+0.04	+0.07	−0.43	+0.81	−1.8	−1.6
21	Cape	ρ Sagittarii	E	+0.80	−0.71	+0.29	+0.40	+0.50	+0.02	+0.07	−0.53	−0.82	−1.1	−1.0
June 6	Cape	o^1 Cancri	I	−1.05	−0.94	+0.24	+0.14	−0.28	−0.10	−0.20	−0.18	−0.79	−0.4	−0.1
10	Cape	γ Virg. (N)	I	−0.80	−0.56	+0.57	−0.29	−0.64	+0.12	−0.27	+0.05	−0.75	+2.5	+2.7
10	Cape	γ Virg. (S)	I	−1.04	−0.73	−0.05	+0.02	+0.05	−0.12	−0.31	−0.05	−0.97	+0.7	+1.0
10	Cape	γ Virg. (N)	EB	+1.00	+0.70	+0.25	−0.13	−0.28	+0.19	+0.29	+0.08	+0.93	−0.1	0.0
10	Cape	γ Virg. (S)	EB	+1.00	+0.70	+0.25	−0.13	−0.28	+0.19	+0.28	+0.08	+0.93	+0.1	+0.2
15	Cape	125 B. Ophiuchi	I	−0.85	+0.27	+0.03	+0.48	+0.48	−0.08	−0.09	−0.50	−0.22	−1.6	−1.3
July 8	Cape	66 Virginis	I	−0.70	−0.46	−0.56	+0.48	+0.73	−0.29	−0.17	−0.28	−0.68	−0.1	+0.1
Aug. 8	Strassburg	24 Scorpii	I	−0.94	+0.07	0.00	−0.20	−0.20	+0.01	−0.16	+0.15	−0.94	+2.0	+2.3
8	Strassburg	24 Scorpii	EB	+0.93	−0.07	−0.01	−0.24	−0.24	+0.15	+0.13	+0.25	+0.93	−1.4	−1.3
8	Pola	24 Scorpii	I	−0.96	+0.07	0.00	−0.13	−0.13	0.00	−0.16	+0.16	−0.96	+1.3	+1.6
8	Prague	24 Scorpii	I	−0.93	+0.07	−0.01	−0.26	−0.26	+0.02	−0.14	+0.27	−0.94	+2.0	+2.3
19	Greenwich	ν Piscium	E	+0.92	−0.49	+0.10	−0.11	+0.15	+0.03	−0.30	+0.04	−0.87	−0.6	−0.5
24	Cape	71 Orionis	E	+0.84	+0.49	−0.25	−0.56	+0.61	+0.11	−0.01	+0.66	−0.65	+0.2	+0.3
Sept. 5	Cape	164 B. Ophiuchi	I	−0.87	+0.15	+0.09	+0.41	+0.42	−0.06	−0.08	−0.44	−0.91	+0.2	+0.5
7	Greenwich	190 B. Sagittarii	I	−0.63	+0.41	+0.45	+0.57	+0.72	+0.06	+0.04	−0.59	−0.64	+2.3	+2.5
Oct. 7	Cape	18 Aquarii	I	−0.90	+0.93	0.00	0.00	0.00	+0.04	+0.22	+0.03	−0.88	−1.7	−1.4
22	Greenwich	44 Leonis	E	+0.61	+0.56	−0.83	−0.02	+0.83	−0.13	+0.18	+0.38	−0.47	0.0	+0.1
Nov. 1	Cape	ρ Sagittarii	I	−0.90	+0.54	−0.20	−0.20	−0.28	−0.02	+0.06	+0.27	−0.84	+1.0	+1.2
12	Strassburg	γ Tauri	IB	−0.92	−0.02	0.00	−0.39	+0.39	+0.03	+0.16	+0.28	+0.30	+2.1	+2.3
12	Strassburg	γ Tauri	E	+0.81	+0.02	−0.01	−0.59	+0.59	+0.13	−0.13	+0.57	−0.26	−0.1	+0.1
12	Cape	64 Tauri	E	+0.88	+0.02	+0.02	+0.48	−0.48	−0.02	−0.16	−0.44	−0.28	−0.9	−0.7
14	Cape	68 Orionis	E	+0.86	+0.35	+0.26	+0.48	−0.55	+0.06	−0.03	−0.59	−0.56	−1.0	−0.8
Dec. 3	Prague	h Aquarii	I	−0.90	+1.00	−0.05	+0.01	−0.05	+0.02	+0.29	−0.02	−1.00	−0.8	−0.6
3	Greenwich	h Aquarii	I	−0.85	+0.95	−0.31	+0.06	−0.32	−0.05	+0.27	+0.04	−0.95	−1.3	−1.1
3	Greenwich	84 Aquarii	I	−0.90	+1.00	−0.03	+0.01	−0.03	+0.03	+0.30	−0.04	−1.00	−1.4	−1.2
6	Cape	μ Piscium	I	−0.90	+0.69	−0.18	+0.21	−0.27	−0.08	+0.29	−0.14	−0.78	−0.3	−0.1
18	Greenwich	γ Virginis	E	+0.74	+0.65	+0.58	−0.43	−0.72	+0.32	+0.19	+0.11	−0.69	+3.3	+3.4
1887, Jan. 5	Greenwich	f Tauri	I	−0.90	+0.29	+0.06	−0.38	+0.38	+0.06	+0.24	+0.24	−0.68	+1.2	+1.4
5	Greenwich	f Tauri	EB	+0.80	−0.25	+0.08	−0.57	+0.58	+0.17	−0.18	+0.50	+0.61	−1.5	−1.3
6	Strassburg	θ^2 Tauri	I	−0.61	+0.03	−0.08	−0.79	+0.80	+0.10	+0.12	+0.70	−0.35	−0.2	−0.1
6	Strassburg	θ^2 Tauri	EB	+0.47	−0.02	−0.10	−0.88	+0.89	+0.17	−0.07	+0.82	+0.26	+0.4	+0.5
6	Strassburg	θ^1 Tauri	EB	+0.84	−0.04	−0.06	−0.55	+0.55	+0.15	−0.14	+0.53	+0.46	+0.7	+0.9
6	Greenwich	θ^2 Tauri	EB	+0.75	−0.03	−0.07	−0.67	+0.68	+0.17	−0.12	+0.65	+0.41	+4.9	+5.0

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1887, Jan. 6	Greenwich	α Tauri	I	−0.87	+0.04	+0.07	+0.50	−0.51	−0.14	+0.14	−0.50	−0.48	−1.5	−1.3
11	Cape	7 Leonis	E	+0.93	+0.76	+0.55	+0.09	−0.56	+0.28	+0.16	−0.31	−0.42	−5.6	−5.4
12	Greenwich	45 Leonis	E	+0.81	+0.70	+0.69	−0.03	−0.69	+0.32	+0.17	−0.29	−0.48	−5.6	−5.4
12	Greenwich	ρ Leonis	IB	−1.03	−0.89	+0.39	−0.03	−0.39	−0.06	−0.28	−0.20	+0.61	+1.6	+1.8
12	Greenwich	ρ Leonis	E	+1.01	+0.87	+0.43	−0.03	−0.43	+0.28	+0.24	−0.16	−0.59	+0.1	+0.3
19	Cape	78 B. Ophiuchi	E	+0.84	+0.15	−0.12	−0.51	−0.52	+0.10	+0.12	+0.52	−0.69	+0.8	+1.0
28	Greenwich	4 Ceti	I	−0.71	+0.77	−0.52	+0.31	−0.61	−0.16	+0.23	−0.03	−0.64	−0.4	−0.3
28	Greenwich	5 Ceti	I	−0.55	+0.60	−0.68	+0.40	−0.79	−0.23	+0.16	−0.02	−0.50	−1.3	−1.2
30	Pola	ν Piscium	I	−0.88	+0.75	−0.15	+0.21	−0.26	−0.04	+0.29	−0.16	−0.96	−1.1	−0.9
Feb. 1	Cape	3 B. Tauri	I	−0.84	+0.40	+0.09	−0.44	+0.45	+0.11	+0.25	+0.29	−0.88	−1.2	−1.0
4	Cape	57 Orionis	I	−0.84	−0.19	+0.28	+0.52	−0.59	−0.12	+0.04	−0.54	−0.54	−4.8	−4.6
6	Greenwich	3 Cancri	I	−1.06	−0.64	+0.26	+0.16	−0.30	−0.13	−0.11	−0.33	−0.26	−0.9	−0.7
7	Strassburg	θ Cancri	I	−0.54	−0.38	+0.84	+0.29	+0.88	+0.06	−0.10	−0.74	−0.03	−0.9	−0.8
18	Cape	246 B. Sagittarii	E	+0.72	−0.28	+0.49	+0.40	+0.75	+0.04	+0.07	−0.57	−0.55	−0.8	−0.6
Mar. 2	Prague	α Tauri	I	−0.54	+0.07	+0.15	+0.82	−0.83	−0.15	+0.08	−0.80	−0.56	−0.4	−0.3
2	Prague	α Tauri	EB	+0.57	−0.07	+0.15	+0.79	−0.81	−0.12	−0.11	−0.54	+0.59	+0.5	+0.6
2	Greenwich	α Tauri	I	−0.14	+0.02	+0.97	+0.19	−0.99	−0.01	0.00	−0.92	−0.14	−0.1	−0.1
2	Greenwich	α Tauri	EB	+0.25	−0.03	+0.95	+0.18	−0.97	−0.15	−0.06	−0.95	+0.26	+0.2	+0.3
2	Pola	α Tauri	I	−0.80	+0.10	+0.11	+0.54	−0.56	−0.11	+0.14	−0.55	−0.83	0.0	+0.2
2	Pola	α Tauri	EB	+0.83	−0.10	+0.10	+0.50	−0.51	−0.06	−0.16	−0.44	+0.86	+0.3	+0.5
8	Prague	ρ Leonis	I	−1.08	−0.90	+0.35	−0.04	−0.35	−0.10	−0.27	−0.06	−0.17	+1.2	+1.4
8	Göttingen	ρ Leonis	I	−1.07	−0.89	+0.38	−0.05	−0.38	−0.10	−0.27	−0.07	−0.17	+1.4	+1.6
8	Göttingen	ρ Leonis	EB	+0.99	+0.83	+0.51	−0.07	−0.52	+0.32	+0.21	−0.16	+0.16	+0.8	+1.0
13	Greenwich	γ Libræ	E	+1.03	+0.57	+0.01	−0.26	−0.26	+0.18	+0.22	+0.23	−0.79	−0.7	−0.5
14	Cape	φ Ophiuchi	E	+0.61	+0.23	+0.16	+0.79	+0.80	−0.08	+0.12	−0.71	−0.55	−1.9	−1.7
31	Cape	68 Orionis	I	−0.98	−0.22	−0.08	−0.11	+0.13	−0.05	+0.04	+0.12	−0.99	−2.2	−2.0
Apr. 4	Cape	α Leonis	I	−0.97	−0.81	−0.49	+0.03	+0.49	−0.28	−0.21	+0.25	−0.56	+1.6	+1.8
4	Cape	α Leonis	EB	+1.09	+0.90	+0.22	+0.01	+0.22	+0.12	+0.26	+0.13	+0.62	+0.1	+0.4
6	Cape	b Virginis	I	−1.12	−0.98	+0.17	−0.10	−0.20	−0.14	−0.33	−0.07	−0.30	−0.2	0.0
9	Cape	18 Libræ	E	+0.94	+0.62	+0.10	−0.52	−0.53	+0.29	+0.20	+0.41	−0.31	+0.2	+0.5
15	Cape	47 B. Capricor.	E	+0.80	−0.46	+0.48	+0.18	+0.52	+0.07	−0.12	−0.38	−0.85	−0.9	−0.7
15	Cape	61 B. Capricor.	E	+0.68	−0.39	−0.65	−0.22	−0.68	−0.11	−0.13	−0.59	−0.72	+4.5	+4.7
30	Greenwich	54 Cancri	I	−0.77	−0.54	−0.67	−0.18	+0.69	−0.20	−0.12	+0.51	−0.72	−2.5	−2.3
May 1	Cape	ψ Leonis	I	−1.07	−0.86	+0.03	0.00	−0.03	−0.13	−0.24	−0.07	−0.95	+0.3	+0.5
4	Prague	γ Virginis	I	−0.67	−0.58	+0.58	−0.57	−0.81	+0.16	−0.25	+0.10	−0.32	+0.9	+1.0
June 3	Cape	18 Libræ	I	−1.09	−0.79	0.00	0.00	0.00	−0.16	−0.29	−0.08	−0.54	+0.4	+0.6
13	Cape	4 Ceti	E	+0.42	−0.47	+0.71	−0.53	+0.88	+0.27	−0.10	0.00	−0.47	+0.6	+0.7
13	Cape	5 Ceti	E	+0.58	−0.64	+0.61	−0.46	+0.77	+0.23	−0.15	+0.01	−0.63	0.0	+0.2
July 1	Greenwich	η Libræ	I	−0.53	−0.33	+0.07	+0.87	+0.87	−0.29	−0.09	−0.74	−0.36	−2.7	−2.6
1	Strassburg	η Libræ	I	−0.54	−0.34	+0.08	+0.86	+0.86	−2.27	−0.09	−0.73	−0.37	−3.2	−3.1
1	Strassburg	η Libræ	EB	+0.62	+0.40	+0.07	+0.81	+0.81	−0.13	+0.17	−0.64	+0.44	−2.4	−2.2
6	Strassburg	o Capricor.	E	+0.86	−0.36	+0.45	+0.14	+0.47	+0.09	−0.12	−0.32	−0.21	+0.9	+1.2
16	Strassburg	α Tauri	IB	−0.54	+0.24	+0.25	+0.79	−0.83	−0.17	+0.09	−0.81	+0.38	−1.4	−1.3
16	Strassburg	α Tauri	E	+0.68	−0.30	+0.22	+0.67	−0.70	−0.12	−0.15	−0.60	−0.48	+0.1	+0.3
16	Pola	α Tauri	IB	−0.74	+0.32	+0.19	+0.62	−0.65	−0.14	+0.13	−0.65	+0.52	−1.1	−1.0
29	Cape	φ Ophiuchi	I	−0.86	−0.50	+0.17	+0.52	+0.54	−0.17	−0.15	−0.56	−0.76	−0.4	−0.3
Aug. 1	Cape	190 B. Sagittarii	I	−0.85	0.00	+0.41	+0.30	+0.51	−0.03	+0.03	−0.55	−0.45	−1.7	−1.6
1	Cape	d Sagittarii	I	−0.71	0.00	−0.58	−0.37	−0.69	−0.07	+0.02	+0.62	−0.37	+1.2	+1.3
5	Cape	64 Aquarii	E	+0.89	−0.76	+0.28	−0.08	+0.29	+0.08	−0.26	−0.07	−0.29	−1.5	−1.2
8	Greenwich	29 Ceti	E	+0.55	−0.60	−0.43	+0.66	−0.79	−0.30	−0.26	−0.16	−0.52	+0.7	+0.9
14	Cape	χ^2 Orionis	E	+0.94	−0.07	+0.22	+0.26	+0.34	+0.04	−0.07	−0.38	−0.70	−0.7	−0.4
31	Greenwich	45 Capricor.	I	−0.92	+0.58	+0.15	−0.01	+0.15	+0.05	+0.24	−0.16	−0.39	−1.9	−1.8
Sept. 3	Cape	27 Piscium	E	+0.70	+0.74	+0.50	−0.40	+0.64	+0.19	−0.21	−0.01	−0.17	+1.5	+1.7
3	Cape	29 Piscium	E	+0.88	−0.93	+0.19	−0.16	+0.25	+0.06	−0.30	+0.04	−0.21	−0.4	−0.1
13	Cape	θ Cancri	E	+0.77	+0.32	−0.67	−0.16	+0.69	−0.01	+0.12	+0.59	−0.50	0.0	−0.2
Oct. 12	Strassburg	α Leonis	IB	−1.06	−0.71	−0.20	+0.04	+0.21	−0.20	−0.24	+0.06	+0.73	−0.2	−0.1
12	Greenwich	α Leonis	IB	−1.09	−0.72	−0.04	+0.01	+0.04	−0.17	−0.26	−0.02	+0.75	−0.5	−0.4
12	Greenwich	α Leonis	E	+1.09	+0.72	−0.03	+0.01	+0.03	+0.14	+0.27	+0.06	−0.75	−1.0	−0.7
26	Greenwich	70 Aquarii	I	−0.89	+0.66	+0.22	−0.09	+0.24	+0.09	+0.30	−0.15	−0.87	−1.1	−1.0
28	Greenwich	54 B. Ceti	I	−0.65	+0.69	+0.46	−0.52	+0.69	+0.27	+0.29	−0.02	−0.43	−1.1	−1.1
Nov. 7	Cape	δ Cancri	E	+0.97	+0.40	−0.27	−0.03	+0.27	+0.03	−0.16	+0.23	−0.96	−1.4	−1.1
21	Cape	42 Capricor.	I	−0.75	+0.29	−0.61	+0.08	−0.62	−0.16	+0.15	+0.35	−0.76	−0.3	−0.3
22	Cape	σ Aquarii	I	−0.63	+0.40	−0.68	+0.25	−0.73	−0.19	+0.15	+0.30	−0.68	+0.2	+0.2
22	Cape	58 Aquarii	I	−0.77	+0.50	+0.51	−0.19	+0.55	+0.16	+0.27	−0.24	−0.84	−3.6	−3.6
24	Cape	4 Ceti	I	−0.87	+0.85	+0.18	−0.19	+0.26	+0.11	+0.34	−0.05	−0.91	−0.1	−0.1
24	Cape	5 Ceti	I	−0.89	+0.87	+0.08	−0.09	+0.12	+0.07	+0.34	−0.05	−0.93	−1.3	−1.3
24	Cape	19 B. Ceti	I	−0.80	+0.78	−0.31	+0.33	−0.45	−0.12	+0.28	−0.04	−0.84	−0.2	−0.2
Dec. 17	Cape	ρ Capricor.	I	−1.01	+0.05	−0.01	0.00	−0.01	−0.07	+0.14	+0.01	−0.51	−1.5	−1.5
17	Cape	34 B. Capricor.	I	−0.98	+0.05	+0.25	+0.04	+0.26	−0.04	+0.15	−0.28	−0.49	−0.1	−0.1
27	Greenwich	75 Tauri	I	−0.92	+0.72	−0.07	−0.15	+0.16	+0.04	+0.21	+0.08	−0.48	−0.1	−0.1

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	ϑ	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1888, Jan. 15	Cape	μ Capricor.	I	−0.97	+0.37	+0.06	−0.02	+0.06	−0.02	+0.24	−0.10	−0.43	−1.0	−1.0
27	Cape	85 Geminor.	I	−0.48	−0.02	−0.86	−0.02	+0.88	−0.12	−0.04	+0.77	−0.04	+0.7	+0.7
Mar. 9	Cape	44 Capricor.	E	+0.73	−0.16	−0.63	+0.15	−0.65	−0.13	−0.20	+0.44	−0.43	−0.1	+0.2
9	Cape	45 Capricor.	E	+0.49	−0.11	+0.83	−0.20	+0.86	+0.21	−0.09	−0.55	−0.29	−2.5	−2.0
18	Cape	δ Tauri	I	−0.73	+0.67	−0.28	−0.52	+0.59	+0.14	+0.18	+0.46	−0.77	−1.0	−1.0
25	Cape	l Leonis	I	−0.24	−0.14	−0.83	+0.52	+0.98	−0.32	−0.01	+0.35	−0.07	+0.2	+0.2
July 17	Cape	ξ Libræ	I	−0.84	−0.78	+0.15	+0.61	+0.63	−0.32	−0.20	−0.45	−0.76	−1.7	−1.7
17	Cape	18 Libræ	I	−0.49	−0.45	−0.22	−0.87	−0.89	+0.20	−0.11	+0.57	−0.44	+1.0	+1.0
20	Cape	16 G. Sagittarii	I	−1.08	−0.77	−0.14	−0.09	−0.17	−0.16	−0.09	+0.10	−0.63	−0.3	−0.3
21	Cape	36 Sagittarii	I	−0.63	−0.38	−0.77	−0.26	−0.81	−0.09	−0.01	+0.76	−0.21	+1.7	+1.7
21	Cape	ξ Sagittarii	I	−0.59	−0.35	+0.79	+0.27	+0.84	−0.09	+0.01	−0.77	−0.20	−4.5	−4.5
21	Cape	ξ Sagittarii	EB	+0.59	+0.35	+0.79	+0.26	+0.84	+0.09	+0.02	−0.86	+0.20	−4.3	−4.0
23	Cape	19 Capricor.	E	+1.04	+0.21	−0.09	+0.01	−0.09	+0.14	+0.17	+0.07	+0.04	+0.3	+0.8
23	Cape	21 Capricor.	E	+0.79	+0.16	−0.64	+0.12	−0.66	−0.02	−0.16	+0.52	+0.03	−3.9	−3.5
23	Cape	θ Capricor.	E	+1.04	+0.21	−0.09	+0.02	−0.09	+0.10	−0.19	+0.08	+0.04	+2.3	+2.8
25	Cape	70 Aquarii	E	+0.48	0.00	−0.70	+0.53	−0.88	−0.23	−0.21	+0.37	−0.18	+0.4	+0.6
28	Cape	35 Ceti	E	+0.91	−0.79	−0.03	+0.11	−0.12	−0.05	−0.37	+0.04	−0.85	−0.7	−0.3
Aug. 17	Cape	121 B. Sagittarii	I	−0.63	−0.43	+0.75	+0.29	+0.81	−0.11	0.00	−0.75	−0.46	−2.2	−2.2
20	Pola	γ Capricor.	I	−0.94	−0.08	+0.35	−0.14	+0.38	+0.01	+0.22	−0.31	−0.25	−4.5	−4.5
Sept. 13	Cape	15 Sagittarii	I	−0.96	−0.79	−0.37	−0.18	−0.42	−0.10	−0.07	+0.34	−0.91	+4.8	+4.8
13	Cape	21 Sagittarii	I	−0.67	−0.51	−0.71	−0.30	−0.77	−0.04	+0.04	+0.72	−0.64	+4.0	+4.0
16	Pola	30 Capricor.	I	−1.00	−0.26	+0.04	−0.01	+0.04	−0.07	+0.21	−0.09	−0.78	+1.7	+1.6
Oct. 9	Cape	29 Ophiuchi	I	−0.79	−0.71	−0.52	−0.45	−0.69	0.00	−0.14	+0.59	−0.58	+1.2	+1.2
13	Pola	20 Capricor.	I	−0.87	−0.37	−0.49	+0.12	−0.50	−0.15	+0.16	+0.30	−0.84	+3.0	+2.9
15	Cape	70 Aquarii	I	−0.94	+0.05	−0.15	+0.14	−0.21	−0.10	+0.29	+0.03	−0.77	+0.6	+0.5
20	Greenwich	μ Ceti	IB	−0.77	+0.79	−0.13	−0.51	+0.53	+0.18	+0.31	+0.25	+0.14	−0.4	−0.5
Nov. 15	Cape	ν Piscium	I	−0.72	+0.58	+0.01	−0.61	+0.61	+0.23	+0.34	+0.15	−0.45	+1.5	+1.4
Dec. 20	Cape	μ Cancri	E	+0.93	−0.53	−0.05	+0.01	+0.05	+0.01	+0.10	+0.05	−0.55	−0.8	−0.3
1889, Jan. 8	Cape	35 Ceti	I	−0.34	+0.19	+0.08	−0.93	+0.93	+0.34	+0.21	+0.20	−0.36	+0.8	+0.8
12	Göttingen	64 Tauri	I	−0.80	+0.89	+0.32	+0.33	−0.46	−0.08	+0.21	−0.50	−0.65	−0.6	−0.7
14	Cape	141 Tauri	I	−0.38	+0.39	+0.84	+0.35	−0.91	−0.07	+0.02	−0.87	−0.17	−0.9	−0.9
Feb. 5	Cape	ν Piscium	I	−0.40	+0.26	−0.07	−0.90	+0.90	+0.33	+0.22	+0.31	−0.38	−0.9	−0.9
9	Greenwich	i Tauri	I	−0.51	+0.56	−0.66	−0.51	+0.83	+0.17	+0.13	+0.74	−0.52	−1.3	−1.3
12	Greenwich	63 Geminor.	I	−0.55	+0.45	+0.81	+0.02	−0.81	+0.03	−0.03	−0.81	−0.32	−0.5	−0.6
Mar. 10	Cape	η Geminor.	I	−0.79	+0.84	−0.46	−0.13	+0.48	+0.05	+0.07	+0.44	−0.85	+1.4	+1.3
11	Cape	44 Geminor.	I	−0.46	+0.42	−0.86	−0.07	+0.86	−0.01	0.00	+0.79	−0.45	−0.2	−0.2
23	Cape	14 Sagittarii	E	+1.06	+0.97	−0.10	−0.03	−0.11	+0.16	+0.07	+0.18	−1.00	−3.1	−2.6
Apr. 20	Cape	30 Sagittarii	E	+1.03	+0.90	+0.30	+0.03	+0.30	+0.15	+0.01	−0.21	−0.87	−4.3	−3.8
20	Cape	31 Sagittarii	E	+0.79	+0.68	−0.68	−0.07	−0.69	+0.13	0.00	+0.74	−0.66	−1.8	−1.4
June 5	Cape	167 B. Leonis	I	−0.89	+0.21	−0.23	+0.26	+0.35	−0.14	−0.27	+0.06	−0.94	−0.7	−0.8
5	Cape	46 Leonis	I	−0.77	+0.18	+0.38	−0.45	−0.59	+0.15	−0.28	−0.22	−0.81	−0.1	−0.2
10	Cape	13 Libræ	I	−0.94	−0.70	+0.46	+0.27	+0.53	−0.35	−0.25	−0.38	−0.43	−2.7	−2.8
July 19	Cape	64 Ceti	E	+0.94	−0.44	−0.02	−0.05	+0.05	+0.05	−0.36	+0.10	−1.00	−1.5	−1.0
Aug. 8	Cape	168 B. Sagittarii	I	−0.52	−0.44	+0.89	−0.02	+0.89	−0.10	+0.01	−0.90	−0.26	−4.2	−4.3
Sept. 4	Cape	ν^2 Sagittarii	I	−0.50	−0.45	+0.89	−0.05	+0.89	−0.08	0.00	−0.91	−0.40	−3.1	−3.1
16	Greenwich	ζ Tauri	IB	−0.67	+0.73	−0.64	−0.18	+0.67	+0.10	+0.12	+0.57	+0.75	−2.2	−2.3
30	Cape	190 B. Ophiuchi	I	−1.03	−0.92	−0.26	−0.08	−0.27	−0.12	−0.15	+0.18	−0.90	+1.0	+0.9
Oct. 5	Greenwich	56 Aquarii	I	−0.78	−0.46	−0.39	+0.56	−0.68	−0.31	+0.20	+0.24	−0.52	+0.3	+0.2
29	Greenwich	208 B. Sagittarii	I	−1.07	−0.98	−0.18	+0.03	−0.18	−0.17	+0.03	+0.08	−0.89	+0.8	+0.7
Nov. 29	Cape	74 Aquarii	I	−1.00	−0.64	−0.12	+0.24	−0.27	−0.22	+0.31	+0.12	−0.96	+1.3	+1.2
Dec. 1	Cape	15 Ceti	I	−0.25	−0.06	+0.05	+0.97	−0.97	−0.41	+0.01	−0.14	−0.24	−1.7	−1.7
29	Cape	33 Ceti	I	−0.65	−0.11	−0.17	−0.73	+0.75	+0.25	+0.33	+0.12	−0.67	0.0	−0.1
31	Greenwich	85 Ceti	I	−0.69	+0.20	+0.41	+0.54	−0.68	−0.27	+0.22	−0.62	−0.67	+0.1	0.0
31	Cape	38 Arietis	I	−0.70	+0.21	+0.41	+0.52	−0.66	−0.25	+0.22	−0.44	−0.68	−1.0	−1.1
1890, Jan. 3	Göttingen	l Tauri	I	−0.38	+0.34	−0.87	−0.26	+0.91	+0.17	+0.10	+0.83	−0.22	−1.4	−1.4
15	Greenwich	o Libræ	E	+0.97	−0.49	+0.23	+0.25	+0.34	0.00	+0.34	−0.18	−0.83	+1.8	+2.3
Feb. 7	Göttingen	ν Virginis	I	−0.94	+0.41	0.00	−0.01	−0.01	−0.02	−0.38	−0.05	+0.64	−3.3	−3.4
7	Göttingen	ν Virginis	E	+0.92	−0.40	+0.03	−0.22	−0.23	+0.12	+0.35	+0.03	−0.62	+2.3	+2.8
7	Greenwich	ν Virginis	IB	−0.94	+0.41	−0.01	+0.09	+0.09	−0.06	−0.37	−0.01	+0.64	−3.0	−3.1
7	Greenwich	ν Virginis	E	+0.94	−0.41	+0.01	−0.07	−0.07	+0.06	+0.38	+0.07	−0.64	+1.8	+2.3
12	Cape	θ Libræ	E	+0.88	+0.58	−0.45	−0.28	−0.53	+0.25	+0.21	+0.50	−0.83	−2.0	−1.6
14	Göttingen	4 Sagittarii	E	+0.51	+0.44	−0.89	−0.03	−0.89	+0.16	+0.05	+0.92	−0.37	−0.7	−0.4
Mar. 14	Cape	117 B. Sagittarii	E	+0.97	+0.86	−0.43	+0.06	−0.43	+0.17	+0.02	+0.51	−0.85	−1.7	−1.2
Apr. 7	Cape	30 Libræ	E	+0.96	+0.43	−0.31	−0.23	−0.39	+0.25	+0.27	+0.35	−0.59	+0.8	+1.3
7	Greenwich	32 Libræ	E	+0.69	+0.31	−0.62	−0.43	−0.75	+0.32	+0.17	+0.58	−0.42	−0.8	−0.5
15	Cape	ψ^3 Aquarii	E	+1.06	+0.72	−0.03	+0.14	−0.15	+0.11	−0.38	+0.12	−0.67	−0.3	+0.2
28	Cape	η Leonis	I	−0.76	+0.73	−0.27	+0.48	+0.55	−0.16	−0.22	+0.25	−0.77	−3.1	−3.2
30	Greenwich	ν Virginis	I	−0.75	+0.42	+0.04	−0.62	−0.62	+0.20	−0.36	−0.14	−0.51	−0.4	−0.5
30	Greenwich	ν Virginis	EB	+0.55	−0.44	+0.05	−0.82	+0.82	+0.35	+0.16	−0.06	+0.37	−5.3	−5.0
May 3	Greenwich	95 Virginis	I	−0.18	−0.02	−0.81	+0.56	+0.99	−0.40	+0.02	−0.52	−0.01	−1.2	−1.2

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1890, May 3	Greenwich	κ Virginis	I	−0.32	−0.03	+0.57	+0.76	+0.95	−0.40	−0.05	−0.52	−0.02	+0.7	+0.7
9	Cape	329 B. Sagittarii	E	+0.79	+0.71	−0.60	+0.34	−0.69	+0.06	−0.09	+0.48	−0.66	−3.0	−2.6
30	Cape	566 B. Virginis	I	−0.89	+0.04	+0.23	+0.40	+0.47	−0.12	−0.14	−0.28	−0.54	+0.7	+0.6
June 2	Greenwich	ω Ophiuchi	IB	−0.92	−0.51	+0.53	+0.16	+0.55	−0.28	−0.19	−0.57	−0.03	−1.3	−1.4
4	Cape	24 Sagittarii	E	+1.11	+0.90	+0.09	−0.02	+0.09	+0.21	+0.05	0.00	−0.40	+1.3	+1.9
5	Cape	53 Sagittarii	E	+0.87	+0.76	−0.56	+0.28	−0.63	+0.12	−0.07	+0.65	−0.46	−1.7	−1.3
5	Cape	274 B. Sagittarii	E	+0.86	+0.76	−0.57	+0.28	−0.63	+0.12	−0.06	+0.65	−0.46	−0.6	−0.2
6	Cape	17 Capricor.	E	+1.10	+0.99	+0.12	−0.11	+0.16	+0.24	−0.18	−0.11	−0.73	−1.3	−0.7
29	Greenwich	56 B. Scorpii	EB	+1.08	+0.52	+0.07	+0.03	+0.07	+0.15	+0.28	+0.01	+0.51	−1.7	−1.2
29	Greenwich	β Scorpii	EB	+1.08	+0.52	+0.07	+0.03	+0.07	+0.15	+0.28	+0.01	+0.51	−5.7	−5.2
29	Göttingen	β Scorpii	EB	+1.08	+0.52	+0.05	+0.02	+0.05	+0.16	+0.29	+0.03	+0.50	−3.0	−2.5
July 12	Göttingen	ε Tauri	E	+0.46	−0.18	−0.84	−0.23	+0.87	+0.22	−0.10	+0.85	−0.38	−3.1	−2.9
21	Cape	ω Virginis	I	−0.88	+0.66	0.00	+0.24	+0.24	−0.09	−0.36	−0.05	−0.80	−0.3	−0.4
Aug. 26	Cape	208 B. Sagittarii	I	−1.05	−0.86	−0.29	+0.14	−0.32	−0.21	+0.03	+0.23	−0.67	+0.6	+0.7
Sept. 1	Cape	f Piscium	E	+1.02	+0.53	−0.16	−0.30	+0.34	+0.31	−0.35	+0.04	−0.47	−0.7	−0.2
6	Greenwich	394 B. Tauri	E	+0.82	−0.49	+0.47	−0.04	−0.47	−0.04	−0.12	−0.38	−0.87	+1.0	+1.4
20	Greenwich	24 Ophiuchi	I	−0.80	−0.41	−0.62	−0.05	−0.62	+0.04	−0.18	+0.52	−0.77	−0.7	−0.8
27	Greenwich	33 Piscium	IB	−1.02	−0.72	−0.07	−0.42	+0.42	−0.02	−0.41	−0.11	−0.18	+4.7	+4.6
30	Cape	31 Arietis	E	+1.00	+0.27	+0.23	+0.19	−0.30	+0.03	−0.39	−0.11	−0.37	+0.6	+1.1
Oct. 24	Cape	351 B. Aquarii	I	−0.32	−0.25	+0.05	+0.96	−0.96	−0.44	+0.02	+0.32	−0.20	+0.6	+0.6
27	Greenwich	ξ^1 Ceti	IB	−0.97	−0.35	+0.29	+0.29	−0.41	−0.31	+0.33	−0.29	−0.15	+0.2	+0.1
Nov. 17	Cape	36 B. Capricor.	I	−0.96	−0.85	−0.30	+0.33	−0.45	−0.22	+0.14	+0.30	−0.83	+2.5	+2.4
20	Cape	ψ^3 Aquarii	I	−1.06	−0.93	0.00	+0.13	−0.13	−0.23	+0.37	−0.04	−0.96	+2.3	+2.2
21	Kasan	33 Piscium	I	−0.79	−0.65	+0.14	+0.66	−0.67	−0.40	+0.26	−0.04	−0.68	+2.5	+2.4
Dec. 1	Cape	79 Cancri	E	+0.25	−0.27	+0.53	+0.80	−0.96	+0.21	+0.04	−0.69	−0.24	−0.9	−0.8
20	Kasan	ν Piscium	I	−0.92	−0.57	−0.29	−0.34	+0.45	+0.08	+0.35	+0.09	−0.87	+3.4	+3.3
23	Cape	53 Tauri	I	−0.52	+0.03	−0.84	−0.13	+0.85	+0.16	+0.18	+0.73	−0.30	−0.9	−1.0

GROUP XIII—1891–1908.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
1891, Jan. 4	Greenwich	2 Libræ	E	+0.92	+0.77	+0.42	+0.32	+0.53	−0.05	+0.38	−0.24	−0.73	−1.4	−0.9
Feb. 12	Göttingen	29 Ceti	I	−0.98	−0.74	−0.26	−0.38	+0.46	+0.02	+0.40	+0.03	−0.64	+1.0	+0.9
17	Greenwich	121 Tauri	I	−0.77	+0.17	+0.57	−0.12	−0.58	−0.11	+0.11	−0.64	−0.78	+2.2	+2.1
20	Cape	λ Cancri	I	−0.72	+0.62	−0.40	+0.47	+0.61	−0.11	−0.12	+0.47	−0.44	−1.2	−1.3
21	Cape	90 H[1]. Cancri	I	−0.88	+0.89	−0.11	+0.21	+0.24	−0.07	−0.23	+0.08	−0.36	−3.0	−3.1
Mar. 15	Cape	56 Tauri	I	−0.43	−0.07	−0.90	−0.06	+0.90	+0.17	+0.14	−0.78	−0.38	−1.2	−1.2
19	Cape	ω^1 Cancri	I	−0.18	−0.13	+0.67	−0.71	−0.98	+0.14	−0.05	−0.88	−0.17	−1.4	−1.4
19	Cape	ω^2 Cancri	I	−0.90	+0.67	−0.09	+0.09	+0.13	−0.03	−0.13	+0.06	−0.91	−0.6	−0.6
26	Hamburg	l Virginis	IB	−0.81	+0.60	−0.33	−0.36	−0.49	+0.19	−0.41	+0.20	+0.30	−3.3	−3.3
26	Greenwich	l Virginis	E	+0.82	−0.61	−0.31	−0.34	−0.46	+0.21	+0.33	+0.25	−0.30	+1.7	+2.1
28	Greenwich	ν Libræ	E	+0.78	−0.23	−0.53	−0.22	−0.57	+0.24	+0.26	+0.48	−0.59	−0.2	+0.2
Apr. 15	Kasan	κ Geminor.	EB	+0.93	−0.60	+0.06	−0.06	−0.10	+0.05	+0.30	−0.04	+1.00	−0.4	0.0
18	Greenwich	42 Leonis	I	−0.84	+0.91	−0.05	+0.36	+0.36	−0.12	−0.30	+0.13	−0.79	+0.2	+0.2
20	Göttingen	ν Virginis	I	−0.87	+0.95	−0.07	−0.26	−0.27	+0.11	−0.42	−0.07	−0.59	−4.7	−4.7
20	Greenwich	ν Virginis	EB	+0.86	−0.93	−0.08	−0.31	−0.32	+0.14	+0.37	+0.03	+0.58	−1.2	−0.9
25	Göttingen	41 Libræ	E	+0.96	−0.16	+0.18	+0.04	+0.18	+0.02	+0.31	−0.07	−0.45	+2.7	+3.1
25	Göttingen	κ Libræ	IB	−0.85	+0.14	+0.48	+0.10	+0.49	−0.21	−0.24	−0.50	+0.40	−5.4	−5.4
25	Göttingen	κ Libræ	E	+0.95	−0.16	+0.20	+0.04	+0.20	+0.01	+0.31	+0.05	−0.45	+1.2	+1.6
25	Hamburg	κ Libræ	E	+0.96	−0.16	+0.15	+0.03	+0.15	+0.03	+0.31	0.00	−0.46	+1.3	+1.7
May 4	Cape	54 B. Ceti	E	+1.11	+0.93	+0.01	+0.03	−0.03	+0.20	−0.43	+0.08	−0.65	−0.5	−0.1
10	Göttingen	121 Tauri	I	−0.69	+0.06	−0.70	+0.21	+0.73	+0.02	+0.10	+0.66	−0.32	−2.8	−2.8
14	Cape	ξ Cancri	I	−0.88	+0.80	−0.11	+0.24	+0.26	−0.08	−0.24	+0.12	−0.94	0.0	0.0
14	Cape	79 Cancri	I	−0.91	+0.82	0.00	+0.01	+0.01	−0.02	−0.25	−0.08	−0.96	−1.8	−1.8
28	Cape	φ Capricor.	E	+0.81	+0.68	−0.24	+0.59	−0.64	−0.03	−0.23	+0.53	−0.73	−1.9	−1.6
June 12	Kasan	i Leonis	I	−0.58	+0.62	+0.02	−0.77	−0.77	+0.26	−0.29	−0.26	−0.60	−0.2	−0.2
July 18	Cape	157 B. Ophiuchi	I	−1.02	−0.07	+0.11	−0.03	+0.12	−0.15	−0.16	−0.19	−0.53	+0.6	+0.6
18	Cape	Pi. XVII 31	I	−0.57	−0.04	+0.80	−0.22	+0.83	−0.20	−0.07	−0.85	−0.30	−3.8	−3.8
18	Cape	39 Ophiuchi	I	−0.56	−0.04	+0.81	−0.22	+0.84	−0.20	−0.07	−0.85	−0.29	−4.0	−4.0
22	Cape	ε Capricor.	E	+0.75	+0.58	+0.18	−0.72	+0.75	+0.37	−0.15	−0.49	−0.22	−2.1	−1.8
Aug. 14	Cape	22 Ophiuchi	I	−0.97	+0.04	+0.22	−0.05	+0.23	−0.15	−0.19	−0.29	−0.85	+2.2	+2.2
14	Greenwich	26 Ophiuchi	I	−0.78	+0.03	+0.60	−0.14	+0.62	−0.19	−0.15	−0.65	−0.69	−2.5	−2.5
18	Cape	χ Capricor.	I	−1.13	−0.79	−0.02	+0.04	−0.05	−0.26	+0.25	+0.01	−0.20	−0.1	−0.1
20	Cape	ψ^1 Aquarii	E	+0.86	+0.75	+0.17	+0.64	−0.66	−0.07	−0.37	+0.22	−0.20	−1.5	−1.2
20	Cape	ψ^2 Aquarii	E	+0.91	+0.79	−0.16	−0.59	+0.61	+0.45	−0.26	−0.10	−0.21	−1.6	−1.3
24	Cape	σ Arietis	E	+0.27	+0.19	−0.92	−0.30	+0.97	+0.39	−0.01	+0.67	−0.23	−3.7	−3.6
Oct. 12	Cape	φ Capricor.	I	−0.86	−0.61	−0.15	+0.57	−0.59	−0.30	+0.19	+0.35	−0.71	+1.8	+1.9
14	Cape	ψ^1 Aquarii	I	−0.74	−0.64	+0.22	+0.72	−0.76	−0.46	+0.19	+0.15	−0.39	−2.2	−2.1
14	Cape	ψ^2 Aquarii	I	−0.98	−0.83	−0.15	−0.49	+0.51	−0.01	+0.40	−0.17	−0.51	−0.1	0.0
15	Göttingen	30 Piscium	I	−0.62	−0.55	−0.40	−0.74	+0.84	+0.24	+0.32	−0.12	−0.26	−0.7	−0.7
15	Greenwich	30 Piscium	I	−0.72	−0.63	−0.37	−0.69	+0.78	+0.18	+0.35	−0.12	−0.30	−0.5	−0.4

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1891, Nov. 6	Cape	σ Sagittarii	I	−0.95	−0.23	+0.20	−0.20	+0.28	−0.10	+0.54	−0.26	−0.84	+1.1	+1.2
6	Cape	σ Sagittarii	EB	+1.02	+0.24	+0.11	+0.11	−0.15	+0.14	−0.28	+0.18	+0.87	−1.3	−1.0
7	Göttingen	ω Sagittarii	I	−1.00	−0.44	+0.10	−0.16	+0.18	−0.10	+0.12	−0.25	−0.94	+3.8	+3.9
10	Göttingen	τ Aquarii	I	−0.41	−0.35	+0.18	+0.91	−0.92	−0.43	+0.07	+0.33	−0.35	+0.7	+0.7
10	Göttingen	τ Aquarii	EB	+0.70	+0.61	+0.15	+0.75	−0.76	−0.17	−0.32	+0.35	+0.62	−5.3	−5.1
10	Kasan	69 Aquarii	I	−1.05	−0.90	−0.04	−0.23	+0.24	−0.10	+0.40	−0.17	−0.91	+3.0	+3.1
10	Kasan	τ Aquarii	I	−0.98	−0.85	+0.08	+0.41	−0.42	−0.33	+0.32	+0.09	−0.86	+2.7	+2.8
10	Hamburg	τ Aquarii	I	−0.26	−0.22	+0.19	+0.96	−0.97	−0.42	+0.02	+0.29	−0.22	+0.5	+0.5
10	Padua	τ Aquarii	I	−0.76	−0.67	+0.13	+0.70	−0.71	−0.40	+0.23	+0.23	−0.68	+0.9	+1.0
10	Padua	τ Aquarii	EB	+0.98	+0.85	+0.08	+0.41	−0.42	+0.01	−0.40	+0.23	+0.85	−3.3	−3.0
19	Cape	υ Geminor.	E	+0.86	−0.14	+0.28	−0.39	−0.48	+0.13	+0.08	−0.46	−0.65	+0.1	+0.4
1892, Jan. 19	Hamburg	γ Virginis	IB	−0.76	+0.86	+0.37	+0.36	+0.52	−0.23	−0.33	−0.11	+0.81	−3.6	−3.5
19	Prague	γ Virginis	IB	−0.78	+0.86	+0.36	+0.36	+0.51	−0.23	−0.32	+0.11	−0.81	−3.0	−2.9
19	Göttingen	γ Virginis	IB	−0.74	+0.82	+0.41	+0.40	+0.57	−0.27	−0.31	−0.12	+0.77	−3.5	−3.4
Feb. 1	Greenwich	376 B. Aquarii	I	−0.94	−0.80	+0.28	+0.45	−0.53	−0.42	+0.32	0.00	−0.56	+1.7	+1.8
7	Greenwich	118 Tauri (S.)	I	−0.96	−0.41	−0.28	+0.16	+0.33	−0.08	+0.13	+0.27	−0.82	−1.2	−1.1
7	Greenwich	118 Tauri (N.)	I	−0.96	−0.42	−0.28	+0.16	+0.32	−0.08	+0.13	+0.27	−0.83	−0.1	0.0
23	Cape	σ Sagittarii	E	+1.00	+0.07	+0.08	−0.10	+0.13	+0.12	−0.03	−0.13	−0.70	+2.0	+2.3
Mar. 8	Greenwich	4 Cancri	I	−0.53	+0.03	+0.34	−0.77	−0.84	+0.07	−0.10	−0.79	−0.47	+0.8	+0.9
16	Hamburg	λ Virginis	E	+0.76	−0.79	−0.52	−0.14	−0.54	+0.22	+0.29	+0.35	−0.56	−0.1	+0.1
Apr. 2	Greenwich	139 Tauri	I	−0.82	−0.36	+0.47	+0.38	+0.61	−0.07	+0.07	+0.55	−0.75	−1.4	−1.2
May 8	Göttingen	θ Virginis	I	−0.82	+0.90	+0.34	+0.20	+0.40	−0.18	−0.36	−0.17	−0.47	−1.5	−1.3
8	Göttingen	θ Virginis	EB	+0.88	−0.97	+0.20	−0.12	+0.23	−0.09	+0.45	−0.01	+0.51	−1.5	−1.3
13	Cape	26 Ophiuchi	E	+0.74	−0.46	+0.53	−0.28	+0.60	−0.07	+0.17	−0.52	−0.35	−1.3	−1.1
June 8	Hamburg	δ Scorpii	I	−0.44	+0.37	−0.85	+0.24	−0.88	+0.22	−0.17	+0.74	−0.13	−0.7	−0.6
14	Santiago	κ Capricor.	E	+0.77	+0.36	+0.05	+0.65	−0.65	−0.10	−0.28	+0.45	−0.65	−1.6	−1.4
July 4	Cape	α Libræ	I	−0.86	+0.92	−0.30	0.00	−0.30	+0.09	−0.39	+0.19	−0.82	0.0	+0.2
6	Cape	ρ Ophiuchi (N.)	I	−0.83	+0.69	+0.41	−0.17	+0.45	−0.15	−0.20	−0.37	−0.53	−0.2	0.0
6	Cape	ρ Ophiuchi (S.)	I	−0.83	+0.69	+0.42	−0.17	+0.45	−0.15	−0.20	−0.37	−0.53	−0.8	−0.6
11	Cape	χ Capricor.	E	+0.29	+0.08	−0.05	+0.96	−0.96	−0.22	−0.13	+0.75	−0.12	−1.0	−0.9
13	Santiago	ψ² Aquarii	IB	−1.04	−0.72	−0.08	−0.13	+0.15	−0.10	+0.45	−0.05	+0.75	−3.3	−3.0
13	Santiago	ψ² Aquarii	E	+1.02	+0.71	−0.14	−0.23	+0.27	+0.28	−0.40	−0.06	−0.74	−3.4	−3.2
19	Hamburg	72 Tauri	IB	−0.84	−0.66	+0.58	−0.25	−0.63	−0.29	+0.18	−0.64	+0.64	−1.3	−1.1
19	Hamburg	υ Tauri	E	+1.07	+0.82	+0.11	−0.05	−0.12	+0.16	−0.26	−0.80	−0.80	+0.2	+0.4
19	Hamburg	72 Tauri	E	+0.92	+0.71	+0.46	−0.20	−0.51	+0.04	−0.24	−0.37	−0.70	−0.9	−0.7
Aug. 2	Santiago	ρ Ophiuchi	I	−0.76	+0.63	−0.52	+0.24	−0.57	+0.09	−0.23	+0.48	−0.75	+1.1	+1.3
3	Cape	88 B. Ophiuchi	I	−0.36	+0.34	−0.78	+0.50	−0.92	+0.14	−0.10	+0.87	−0.32	−2.4	−2.3
4	Santiago	66 B. Sagittarii	I	−0.92	+0.39	+0.19	−0.24	+0.31	−0.08	−0.03	−0.36	−0.64	+3.7	+3.9
11	Greenwich	14 Ceti	E	+0.63	+0.53	−0.67	−0.48	+0.82	+0.50	−0.17	+0.14	−0.42	−1.5	−1.4
Sept. 6	Cape	ψ¹ Aquarii	IB	−1.10	−0.64	+0.05	+0.07	−0.09	−0.26	+0.42	−0.04	0.00	−2.6	−2.3
7	Santiago	10 Ceti	E	+0.73	+0.51	−0.62	−0.45	−0.76	+0.50	−0.20	+0.09	−0.16	−3.4	−3.3
11	Cape	33 Tauri	E	+0.68	+0.59	+0.74	−0.26	−0.78	−0.08	−0.22	−0.72	−0.57	−1.9	−1.8
12	Greenwich	κ Tauri	E	+1.05	+0.83	+0.13	−0.09	−0.16	+0.15	−0.19	−0.08	−0.96	−0.7	−0.5
15	Greenwich	4 Cancri	E	+0.97	+0.30	+0.06	−0.24	−0.25	+0.15	+0.16	−0.17	−0.88	+0.3	+0.5
Oct. 3	Greenwich	τ Aquarii	I	−0.99	−0.50	−0.19	−0.37	+0.42	−0.02	+0.42	−0.22	−0.48	−1.1	−0.8
3	Hamburg	τ Aquarii	I	−0.97	−0.53	−0.21	−0.40	+0.45	0.00	+0.08	−0.24	−0.51	−2.9	−2.6
3	Prague	τ Aquarii	I	−0.92	−0.45	−0.25	−0.48	+0.54	+0.04	+0.41	−0.28	−0.76	−1.7	−1.4
4	Santiago	27 Piscium	I	−1.12	−0.77	+0.08	+0.08	−0.11	−0.29	+0.44	−0.03	−0.33	−1.1	−0.8
31	Göttingen	ψ³ Aquarii	I	−0.43	−0.25	+0.56	+0.73	−0.92	−0.48	+0.08	+0.18	−0.29	+1.6	+1.7
Nov. 30	Greenwich	122 G. Pisc. (1st)	I	−0.50	−0.41	−0.88	−0.20	+0.90	+0.29	+0.30	+0.33	−0.30	−0.7	−0.5
30	Greenwich	122 G. Pisc. (2d)	I	−0.50	−0.41	−0.88	−0.20	+0.90	+0.29	+0.30	+0.33	−0.30	−4.5	−4.3
Dec. 12	Cape	46 Virginis	E	+0.88	−0.76	−0.20	−0.08	−0.22	+0.12	+0.42	+0.11	−0.92	+0.1	+0.1
25	Greenwich	351 B. Aquarii	I	−0.98	−0.57	−0.20	−0.20	+0.28	−0.01	+0.47	−0.11	−0.95	−0.5	−0.1
1893, Feb. 26	Greenwich	c Geminor.	I	−0.68	−0.40	−0.13	+0.75	+0.76	−0.21	−0.09	+0.69	−0.49	−0.9	−0.6
Mar. 25	Cape	ε Geminor.	I	−1.00	−0.69	−0.06	+0.27	+0.28	−0.19	−0.12	+0.22	−0.94	+0.5	+1.0
Apr. 18	Greenwich	32 Tauri	I	−0.85	−0.75	−0.59	+0.37	+0.69	−0.01	+0.24	+0.54	−0.41	−2.4	−2.0
21	Greenwich	47 Geminor.	I	−0.92	−0.68	−0.12	+0.48	+0.50	−0.20	−0.08	+0.46	−0.81	−1.1	−0.6
22	Greenwich	λ Cancri	I	−0.98	−0.56	+0.01	+0.32	+0.32	−0.21	−0.21	+0.25	−0.95	−0.3	+0.2
23	Cape	79 Cancri	I	−0.95	−0.41	+0.09	+0.34	+0.35	−0.23	−0.27	+0.23	−0.92	−0.9	−0.4
May 6	Greenwich	b Sagittarii	E	+0.67	−0.39	+0.03	−0.69	+0.69	+0.14	−0.22	−0.58	−0.71	−2.4	−2.5
8	Cape	ε Capricor.	E	+0.85	−0.12	−0.16	−0.44	+0.47	+0.23	−0.27	−0.29	−0.86	−0.3	−0.4
June 24	Cape	28 G. Libræ	I	−0.97	+0.77	+0.45	−0.15	+0.47	−0.19	−0.29	−0.37	−0.69	−1.2	−0.7
July 1	Cape	χ Capricor.	E	+0.94	−0.37	+0.03	+0.11	−0.12	+0.04	−0.31	+0.15	−0.59	+0.4	+0.2
6	Hamburg	e Piscium	E	+0.71	+0.48	+0.73	+0.10	−0.73	−0.23	−0.38	−0.16	−0.69	+0.6	+0.5
6	Cape	ζ Piscium	E	+0.98	+0.64	−0.34	−0.04	+0.34	+0.27	−0.34	+0.11	−0.93	−2.1	−2.3
9	Greenwich	32 Tauri	E	+1.11	+0.99	−0.07	+0.05	+0.09	+0.25	−0.28	+0.12	−0.71	−1.7	−1.9
30	Greenwich	56 Aquarii	E	+0.97	−0.09	−0.10	−0.12	+0.16	+0.16	−0.40	−0.03	−0.48	+0.9	+0.7
Aug. 2	Cape	171 B. Piscium	E	+0.88	+0.50	+0.52	+0.08	−0.52	−0.10	−0.45	−0.12	−0.78	−2.6	−2.8
21	Cape	3 Sagittarii	I	−0.88	+0.95	−0.10	+0.21	−0.23	−0.02	−0.07	+0.20	−0.86	−1.7	−1.2
Sept. 3	Cape	β Tauri	IB	−0.29	−0.28	+0.50	−0.82	−0.96	−0.16	+0.03	−0.97	+0.28	−1.8	−1.6

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1893, Sept. 23	Cape	70 Aquarii	I	−0.92	+0.08	+0.30	+0.27	−0.40	−0.29	+0.35	+0.14	−0.30	−5.0	−4.4
Oct. 19	Greenwich	37 Capricor.	I	−0.95	+0.47	0.00	0.00	0.00	−0.07	+0.36	−0.04	−0.90	−2.2	−1.6
19	Greenwich	38 Capricor.	I	−0.73	+0.36	−0.31	−0.56	+0.64	+0.16	+0.32	−0.47	−0.69	−3.0	−2.6
20	Cape	50 Aquarii	I	−0.97	+0.25	+0.12	+0.13	−0.17	−0.18	+0.39	−0.08	−0.75	−2.0	−1.3
26	Cape	23 Tauri	E	+0.58	+0.47	−0.66	+0.55	+0.86	+0.37	−0.11	+0.73	−0.21	+2.4	+2.2
26	Cape	20 Tauri	E	+0.81	+0.66	+0.53	−0.44	−0.69	0.00	−0.25	−0.58	−0.29	−1.5	−1.7
30	Greenwich	4 Cancri	E	+0.65	+0.53	+0.10	+0.79	+0.80	−0.03	+0.14	+0.74	−0.57	−0.5	−0.7
Nov. 19	Cape	44 Piscium	I	−0.97	−0.25	+0.97	+0.22	−1.00	−0.01	+0.50	+0.14	−0.70	−0.1	+0.6
22	Greenwich	δ Arietis	I	−0.49	−0.36	−0.77	+0.48	+0.90	+0.19	+0.20	+0.66	−0.07	−1.4	−1.0
24	Cape	β Tauri	IB	−1.10	−0.95	−0.13	+0.26	+0.29	−0.24	+0.11	+0.27	+0.27	+0.9	+1.7
24	Cape	β Tauri	E	+1.12	+0.96	−0.10	+0.22	+0.24	+0.30	−0.10	+0.25	−0.27	+1.2	+0.8
Dec. 13	Pola	χ Capricor.	I	−0.83	+0.48	+0.23	+0.34	−0.41	−0.17	+0.31	+0.30	−0.82	−0.1	+0.5
20	Cape	9 Tauri	I	−0.77	−0.59	−0.56	+0.47	+0.73	+0.03	+0.25	+0.59	−0.35	+0.9	+1.4
20	Cape	17 Tauri	I	−1.13	+0.25	−0.06	+0.06	+0.09	−0.24	+0.30	+0.07	−0.51	−0.3	+0.5
20	Cape	16 Tauri	I	−0.93	−0.72	+0.42	−0.38	−0.56	−0.36	+0.22	−0.41	−0.42	−1.1	−0.4
20	Cape	20 Tauri	I	−0.84	−0.64	+0.49	−0.46	−0.67	−0.37	+0.19	−0.51	−0.38	−0.5	+0.2
1894, Jan. 12	Hamburg	24 Piscium	I	−0.79	−0.02	−0.54	−0.18	+0.57	+0.20	+0.45	−0.07	−0.78	−4.2	−3.6
12	Greenwich	24 Piscium	I	−0.84	−0.02	−0.48	−0.16	+0.50	+0.16	+0.46	−0.06	−0.81	+0.4	+1.1
16	Pola	ζ Arietis	I	−0.91	−0.68	+0.44	−0.33	−0.55	−0.35	+0.24	−0.40	−0.71	+1.1	+1.8
16	Padua	ζ Arietis	I	−0.87	−0.66	+0.48	−0.36	−0.60	−0.13	+0.23	−0.47	−0.70	+0.1	+0.8
16	Padua	τ Arietis	I	−0.88	−0.67	−0.45	+0.35	+0.57	+0.01	+0.29	+0.43	−0.71	−1.1	−0.4
18	Cape	β Tauri	I	−1.09	−0.95	−0.11	+0.26	+0.29	−0.23	+0.10	+0.27	−0.54	+1.1	+2.0
20	Greenwich	c Geminor.	I	−0.78	+0.65	+0.10	+0.73	+0.74	+0.07	+0.12	+0.71	+0.11	−4.3	−3.7
Feb. 13	Greenwich	36 Tauri	I	−0.65	−0.54	−0.48	+0.61	+0.79	+0.06	+0.17	+0.70	−0.58	−2.9	−2.4
15	Santiago	κ Aurigæ	I	−0.96	−0.87	+0.10	−0.49	−0.50	−0.19	0.00	−0.51	−0.68	+0.7	+1.5
16	Santiago	ι Geminor.	I	−0.71	−0.61	+0.07	+0.77	+0.77	−0.25	−0.08	+0.72	−0.40	+1.4	+2.0
16	Santiago	b^2 Geminor.	I	−0.84	−0.74	−0.07	−0.66	−0.66	−0.08	−0.13	−0.61	−0.49	+1.3	+2.0
26	Santiago	σ Scorpii	IB	−0.40	+0.37	+0.54	−0.72	+0.90	−0.19	−0.07	−0.83	+0.44	−0.6	−0.3
26	Santiago	σ Scorpii	E	+0.69	−0.64	+0.38	−0.52	+0.65	−0.12	+0.19	−0.57	−0.76	+1.3	+1.0
28	Cape	10 G. Sagittarii	E	+0.77	−0.84	−0.13	+0.50	−0.51	+0.04	+0.03	+0.53	−0.82	−0.5	−0.9
Mar. 14	Göttingen	136 Tauri	I	−0.38	−0.35	−0.22	+0.91	+0.94	−0.04	+0.01	+0.94	−0.36	−0.4	0.0
16	Kasan	c Geminor.	I	−0.36	−0.33	+0.17	+0.93	+0.94	−0.22	−0.05	+0.87	−0.30	−1.2	−0.9
16	Cape	φ Geminor.	I	−1.02	−0.91	+0.07	+0.32	+0.33	−0.26	−0.18	+0.23	−0.83	+2.4	+3.3
16	Greenwich	4 Cancri	I	−1.05	−0.93	−0.06	−0.24	−0.25	−0.15	−0.21	−0.25	−0.84	+0.4	+1.3
17	Santiago	ξ Cancri	I	−0.82	−0.65	−0.34	−0.56	−0.66	+0.04	−0.29	−0.43	−0.56	+0.7	+1.4
17	Santiago	90 H^1 Cancri	I	−1.06	−0.83	−0.12	−0.19	−0.22	−0.14	−0.33	−0.06	−0.72	+3.1	+4.0
22	Pola	a Virginis	IB	−1.00	+0.09	+0.09	−0.02	+0.09	−0.17	−0.44	−0.04	+0.22	−3.9	−3.0
23	Greenwich	40 H. Virginis	E	+0.91	−0.33	−0.36	+0.16	−0.39	+0.25	+0.34	+0.22	−0.42	0.0	−0.5
25	Greenwich	2 Scorpii	E	+0.93	−0.73	+0.05	−0.06	+0.08	+0.04	+0.27	−0.07	−0.80	0.0	−0.5
25	Greenwich	3 Scorpii	E	+0.79	−0.61	−0.35	+0.41	−0.54	+0.19	+0.21	+0.48	+0.47	−0.7	−1.1
31	Cape	χ Capricor.	E	+0.53	−0.47	−0.42	−0.70	+0.82	+0.28	−0.14	−0.61	−0.47	+0.1	−0.2
Apr. 9	Greenwich	χ Tauri	I	−1.06	−0.84	+0.10	−0.15	−0.18	−0.23	+0.21	−0.18	−0.76	−0.2	+0.8
9	Hamburg	χ. Tauri	I	−0.98	−0.78	+0.23	−0.35	−0.42	−0.27	+0.20	−0.40	−0.71	+1.1	+2.1
10	Greenwich	107 B Aurigæ	I	−1.08	−0.95	−0.03	+0.11	+0.11	−0.20	+0.07	+0.11	−0.90	−0.8	+0.2
11	Greenwich	49 Aurigæ	I	−1.04	−0.96	+0.02	−0.29	−0.29	−0.19	−0.04	−0.31	−0.94	+1.5	+2.5
11	Pola	49 Aurigæ	I	−1.03	−0.95	+0.02	−0.33	−0.33	−0.19	−0.05	−0.33	−0.93	+0.9	+1.9
11	Hamburg	49 Aurigæ	I	−0.88	−0.81	+0.03	−0.58	−0.58	−0.14	−0.04	−0.59	−0.79	+1.1	+1.9
12	Göttingen	c Geminor.	I	−1.08	−0.98	0.00	−0.02	−0.02	−0.21	−0.17	−0.01	−1.00	+1.6	+2.6
24	Cape	38 B. Sagittarii	E	+0.82	−0.88	+0.07	−0.41	+0.42	+0.03	+0.02	−0.41	−0.76	+1.0	+0.6
25	Cape	τ Sagittarii	E	+0.88	−0.97	+0.02	+0.23	−0.23	+0.02	−0.11	+0.25	−0.91	+1.8	+1.4
29	Cape	50 Aquarii	E	+0.66	−0.43	−0.56	−0.44	+0.71	+0.34	−0.23	−0.34	−0.62	+0.4	+0.1
29	Cape	182 B. Aquarii	E	+0.44	−0.28	−0.71	−0.52	+0.89	+0.40	−0.10	−0.40	−0.41	+4.1	+3.9
May 2	Cape	147 B. Piscium	E	+0.82	+0.06	−0.59	+0.02	+0.59	+0.40	−0.31	+0.14	−0.32	+0.9	+0.4
12	Greenwich	37 Leonis	I	−0.94	−0.70	−0.34	−0.28	−0.44	+0.03	−0.41	−0.22	−0.90	+0.7	+1.6
14	Kasan	β Virginis	I	−0.71	−0.31	−0.70	−0.16	−0.72	+0.25	−0.42	−0.07	−0.64	+1.5	+2.2
21	Cape	10 G. Sagittarii	E	+0.45	−0.48	−0.14	+0.86	−0.87	+0.04	0.00	+0.87	−0.22	+0.6	+0.3
30	Greenwich	ζ Piscium	E	+0.83	+0.13	−0.58	+0.11	+0.59	+0.39	−0.31	+0.19	−0.55	−0.7	−1.2
July 15	Cape	38 B. Sagittarii	I	−0.58	+0.59	+0.07	−0.76	+0.76	−0.02	+0.01	−0.77	−0.31	−2.8	−2.2
17	Padua	A Sagittarii	I	−0.83	+0.93	+0.13	+0.35	−0.37	−0.08	+0.20	+0.31	−0.02	+0.5	+1.4
Aug. 4	Cape	β Virginis	I	−0.97	−0.51	+0.43	+0.06	+0.43	−0.39	−0.37	+0.03	−0.55	−2.4	−1.3
23	Padua	28 Tauri	E	+0.88	−0.53	+0.30	−0.44	−0.53	+0.01	−0.25	−0.47	−0.84	+1.3	+0.7
23	Padua	27 Tauri	IB	−0.87	+0.54	+0.31	−0.45	−0.55	−0.27	+0.21	−0.44	+0.83	−0.2	+0.7
23	Padua	27 Tauri	E	+1.01	+0.61	+0.13	−0.19	−0.24	+0.10	−0.28	−0.20	−0.96	+0.6	−0.1
Sept. 11	Padua	χ Capricor.	I	−0.23	+0.23	+0.63	+0.74	−0.97	−0.31	+0.03	+0.73	−0.15	+0.9	+1.1
21	Cape	116 B. Aurigæ	E	+0.59	+0.47	−0.11	+0.82	+0.83	+0.15	−0.03	+0.83	−0.56	−1.3	−1.7
Oct. 7	Prague	A Sagittarii	I	−0.57	+0.62	+0.33	+0.70	−0.78	−0.17	+0.12	+0.71	−0.62	−1.5	−0.9
7	Padua	A Sagittarii	I	−0.60	+0.65	+0.31	+0.67	−0.74	−0.17	+0.12	+0.69	−0.66	−1.1	−0.4
10	Padua	50 Aquarii	I	−0.89	+0.82	+0.22	+0.12	−0.25	−0.14	+0.40	+0.11	−0.69	−1.5	−0.5
11	Berlin	B. D. − 8° 6040	I	−0.92	+0.71	+0.04	+0.01	−0.05	−0.06	+0.44	−0.01	−0.56	−3.6	−2.6
19	Berlin	B. D. +28° 1095	E	+1.10	+0.92	0.00	−0.06	−0.06	+0.23	+0.03	−0.06	−0.94	−2.1	−2.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													"	"
1894, Oct. 19	Berlin	B. D. +28° 1097	E	+0.98	+0.82	+0.03	+0.45	+0.45	+0.18	+0.03	+0.46	−0.84	−3.6	−4.4
21	Berlin	B. D. +24° 1918	E	+1.02	+0.92	−0.20	−0.34	−0.39	+0.30	+0.22	+0.33	−0.91	−0.4	−1.2
23	Berlin	B. D. +12° 2213	E	+0.53	+0.42	−0.79	−0.39	−0.88	+0.48	+0.12	−0.40	−0.42	−0.6	−1.0
23	Berlin	B. D. +12° 2215	E	+0.74	+0.58	+0.66	+0.33	+0.74	−0.16	+0.38	−0.33	−0.58	+0.2	−0.4
Nov. 7	Berlin	70 Aquarii	I	−0.89	+0.79	+0.19	+0.07	−0.20	−0.12	+0.48	+0.06	−0.89	−1.5	−0.5
7	Berlin	B. D. −11° 5933	I	−0.88	+0.79	−0.20	−0.07	+0.22	+0.07	+0.47	−0.10	−0.88	−1.1	−0.1
7	Berlin	B. D. −11° 5932	I	−0.88	+0.79	+0.23	+0.08	−0.24	−0.07	+0.40	+0.08	−0.88	−1.9	−0.9
7	Berlin	243 B. Aquarii	I	−0.62	+0.55	−0.70	−0.25	+0.74	+0.30	+0.38	−0.25	−0.62	−2.1	−1.4
7	Padua	70 Aquarii	I	−0.91	+0.80	+0.12	+0.05	−0.13	−0.10	+0.44	+0.04	−0.89	−1.4	−0.4
9	Berlin	B. D. + 0° 34	I	−0.88	+0.33	−0.40	+0.04	+0.40	+0.12	+0.50	+0.02	−0.53	+0.9	+1.9
9	Berlin	B. D. + 1° 52	I	−0.41	+0.15	+0.91	−0.10	−0.91	−0.46	+0.10	−0.08	−0.25	−0.4	+0.1
9	Berlin	B. D. + 2° 54	I	−0.42	+0.16	−0.90	+0.10	+0.90	+0.40	+0.32	+0.08	−0.26	−1.5	−1.0
15	Berlin	B. D. +27° 880	E	+0.74	+0.54	−0.01	+0.73	+0.73	+0.15	−0.02	+0.73	−0.37	+0.4	−0.2
15	Berlin	136 Tauri	E	+0.48	+0.35	0.00	+0.90	+0.90	+0.10	−0.01	+0.90	−0.24	−0.3	−0.7
15	Berlin	B. D. +27° 914	E	+0.64	+0.47	0.00	+0.81	+0.81	+0.14	−0.01	+0.81	−0.32	+0.1	−0.4
15	Berlin	B. D. +28° 958	E	+0.85	+0.62	−0.01	−0.62	−0.62	+0.16	0.00	−0.63	−0.43	−1.5	−2.2
15	Berlin	B. D. +28° 966	E	+1.07	+0.77	0.00	−0.21	−0.21	+0.21	−0.03	−0.20	−0.54	−0.3	−1.2
15	Greenwich	136 Tauri	IB	−0.93	−0.67	−0.02	+0.52	+0.52	−0.16	+0.02	+0.52	+0.47	−2.1	−1.0
15	Greenwich	136 Tauri	E	+0.77	+0.56	−0.02	+0.71	+0.71	+0.16	−0.02	+0.70	−0.39	0.0	−0.7
16	Berlin	B. D. +27° 1270	E	+0.84	+0.69	−0.15	−0.62	−0.64	+0.23	+0.07	−0.65	−0.55	−3.0	−3.7
20	Padua	χ Leonis	E	+0.43	+0.35	−0.88	−0.24	−0.91	+0.48	+0.09	−0.60	−0.40	−0.6	−1.0
Dec. 1	Berlin	C. D. −25° 14589	I	−0.85	+0.95	+0.16	+0.27	−0.31	−0.09	+0.23	+0.26	−0.72	−1.0	0.0
2	Cape	η Capricor.	I	−0.86	+0.96	+0.20	+0.21	−0.29	−0.11	+0.30	+0.18	−0.84	−0.8	+0.2
8	Kasan	π Piscium	I	−1.00	+0.09	−0.05	+0.03	+0.06	−0.09	+0.42	+0.02	−0.71	−1.7	−0.4
8	Berlin	π Piscium	I	−0.99	+0.09	−0.03	+0.01	+0.03	−0.10	+0.44	+0.02	−0.71	−2.7	−1.4
8	Berlin	281 B. Piscium	I	−0.84	+0.08	−0.45	+0.24	+0.52	+0.13	+0.43	+0.22	−0.60	−3.7	−2.6
8	Berlin	B. D. +11° 210	I	−0.99	+0.09	−0.01	0.00	+0.01	−0.11	+0.44	+0.01	−0.71	−2.2	−0.9
10	Padua	66 Arietis	I	−0.99	−0.34	−0.20	+0.32	+0.38	−0.07	+0.28	+0.30	−0.33	+0.9	+2.2
11	Padua	χ Tauri	I	−0.76	−0.38	−0.26	+0.67	+0.72	−0.01	+0.16	−0.56	−0.24	−0.8	+0.2
11	Berlin	χ Tauri	I	−0.96	−0.49	−0.15	+0.39	+0.42	−0.09	+0.17	+0.39	−0.16	−2.6	−1.4
1895, Jan. 1	Berlin	B. D. − 8° 5991	I	−0.27	+0.24	+0.91	+0.25	−0.95	−0.44	+0.04	+0.32	−0.27	+1.9	+2.2
20	Cape	α Scorpii	IB	−0.62	+0.20	+0.22	−0.72	+0.75	−0.17	−0.11	−0.64	+0.55	−2.5	−1.7
20	Cape	α Scorpii	E	+0.85	−0.28	+0.13	−0.42	+0.43	−0.01	+0.18	−0.47	−0.76	+1.8	+1.0
31	Berlin	B. D. + 6° 127	I	−0.86	+0.26	−0.43	+0.15	+0.46	+0.13	+0.47	+0.11	−0.86	+0.4	+1.5
Feb. 6	Berlin	B. D. +27° 1141	I	−1.08	−0.82	−0.02	−0.11	−0.11	−0.20	−0.07	−0.10	−0.57	−3.0	−1.6
6	Berlin	49 Aurigæ	I	−0.70	−0.53	−0.13	−0.75	−0.77	−0.09	−0.05	−0.77	−0.37	−1.7	−0.8
6	Greenwich	49 Aurigæ	I	−0.52	−0.39	−0.18	−0.86	−0.88	−0.06	−0.03	−0.88	−0.27	−0.7	0.0
6	Cape	28 Geminor.	I	−0.95	−0.71	−0.13	−0.50	−0.52	−0.17	−0.08	−0.51	−0.50	−2.4	−1.1
6	Cape	53 Aurigæ	I	−1.02	−0.76	+0.09	+0.39	+0.40	−0.26	−0.07	+0.41	−0.53	−3.4	−2.1
7	Berlin	B. D. +25° 1778	I	−0.93	−0.81	+0.26	+0.46	+0.54	−0.30	−0.17	+0.50	−0.29	−2.0	−0.7
8	Berlin	γ Cancri	I	−1.08	−0.96	+0.16	+0.18	+0.24	−0.29	−0.28	+0.21	−0.19	+0.3	+1.7
8	Kasan	γ Cancri	I	−1.08	−0.92	+0.24	+0.27	+0.36	−0.35	−0.27	+0.31	−0.19	−0.5	+0.9
13	Cape	α Virginis	E	+0.61	+0.34	+0.72	−0.39	+0.82	−0.25	+0.35	−0.35	−0.42	−1.6	−2.2
18	Cape	38 B. Sagittarii	E	+0.91	−0.60	−0.01	−0.07	+0.07	+0.05	−0.02	−0.09	−0.90	+1.0	+0.1
Mar. 3	Berlin	B. D. +25° 677	I	−1.04	−0.46	−0.04	+0.12	+0.13	−0.33	−0.23	+0.14	−0.99	+0.5	+1.9
3	Berlin	B. D. +25° 681	I	−0.79	−0.34	+0.20	−0.63	−0.66	−0.25	+0.14	−0.58	−0.75	+1.2	+2.3
3	Berlin	B. D. +25° 682	I	−0.55	−0.24	+0.24	−0.83	−0.86	−0.26	+0.08	−0.77	−0.52	+1.2	+1.9
3	Berlin	B. D. +25° 692	I	−0.71	−0.31	−0.21	+0.70	+0.73	+0.03	+0.17	+0.67	−0.68	−1.1	−0.1
3	Berlin	B. D. +25° 703	I	−0.85	−0.37	−0.15	+0.57	+0.59	−0.03	+0.18	+0.54	−0.81	−1.3	−0.1
4	Berlin	B. D. +27° 738	I	−1.03	−0.65	−0.01	+0.26	+0.26	−0.16	+0.09	+0.27	−0.91	+0.2	+1.6
4	Berlin	B. D. +27° 737	I	−0.55	−0.35	−0.04	+0.87	+0.87	−0.03	+0.06	+0.85	−0.48	−2.1	−1.3
4	Berlin	B. D. +27° 743	I	−1.06	−0.67	+0.01	−0.12	−0.12	−0.20	+0.08	−0.10	−0.94	−1.0	+0.5
4	Berlin	B. D. +27° 744	I	−1.00	−0.63	+0.01	+0.36	+0.36	−0.15	+0.09	+0.37	−0.88	+0.9	+2.3
4	Berlin	B. D. +27° 746	I	−1.06	−0.67	+0.01	+0.17	+0.17	−0.18	+0.09	+0.19	−0.94	−1.5	0.0
5	Berlin	B. D. +27° 1078	I	−0.97	−0.74	+0.07	+0.43	+0.44	−0.20	−0.05	+0.46	−0.77	−0.4	+0.9
5	Berlin	B. D. +28° 1097	I	−0.99	−0.76	−0.07	−0.39	−0.40	−0.17	+0.05	−0.40	−0.79	−0.9	+0.5
5	Berlin	B. D. +27° 1090	I	−0.96	−0.73	+0.08	+0.47	+0.48	−0.21	−0.04	+0.50	−0.77	−1.0	+0.3
5	Berlin	B. D. +27° 1117	I	−1.09	−0.83	+0.01	+0.05	+0.05	−0.22	−0.03	+0.06	−0.87	−2.0	−0.5
6	Berlin	B. D. +26° 1495	I	−0.83	−0.69	+0.24	+0.61	+0.66	−0.25	−0.11	+0.65	−0.58	−0.6	+0.5
6	Berlin	134 B. Geminor.	I	−1.09	−0.91	+0.06	+0.15	+0.16	−0.25	−0.16	+0.17	−0.76	−2.1	−0.6
6	Berlin	B. D. +26° 1514	I	−0.97	−0.81	+0.18	+0.45	+0.48	−0.27	−0.13	+0.48	−0.68	−1.1	+0.2
6	Berlin	B. D. +26° 1516	I	−1.06	−0.88	+0.10	+0.26	+0.28	−0.25	−0.14	+0.28	−0.74	+1.6	+3.0
6	Berlin	B. D. +27° 1362	I	−0.66	−0.55	−0.30	−0.74	−0.80	−0.02	−0.11	−0.77	−0.46	−1.4	−0.5
6	Berlin	B. D. +26° 1525	I	−1.01	−0.85	−0.14	−0.35	−0.38	−0.14	−0.16	−0.36	−0.71	−1.9	−0.5
6	Berlin	B. D. +26° 1528	I	−1.10	−0.92	0.00	0.00	0.00	−0.22	−0.16	+0.02	−0.77	−2.5	−1.0
6	Berlin	B. D. +26° 1531	I	+0.16	+0.14	−0.39	+0.92	+1.00	+0.15	0.00	+0.96	+0.11	+1.5	+1.3
6	Berlin	B. D. +26° 1539	I	−1.08	−0.90	−0.08	−0.18	−0.20	−0.19	−0.17	−0.17	−0.75	−1.3	+0.2
6	Berlin	B. D. +26° 1554	I	−0.90	−0.75	+0.23	+0.51	+0.57	−0.26	−0.13	+0.55	−0.63	−2.3	−1.0
6	Berlin	B. D. +26° 1563	I	−0.85	−0.71	−0.26	−0.59	−0.64	−0.07	−0.15	−0.59	−0.59	−0.4	+0.8
6	Berlin	B. D. +26° 1561	I	−0.72	−0.60	+0.30	+0.70	+0.76	−0.26	−0.10	+0.73	−0.50	−0.2	+0.8

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													"	"
1895, Mar. 6	Berlin	B. D.+26° 1564	I	−0.50	−0.42	+0.36	−0.82	−0.89	+0.05	−0.10	−0.84	−0.35	−0.6	+0.1
6	Berlin	B. D.+26° 1580	I	−1.07	−0.89	−0.10	−0.22	−0.24	−0.18	−0.18	−0.21	−0.75	−1.6	−0.1
8	Berlin	B. D.+18° 2176	I	−1.10	−0.99	+0.09	+0.07	+0.12	−0.27	−0.35	+0.10	−0.43	−2.5	−1.0
8	Berlin	B. D.+18° 2181	I	−0.91	−0.82	−0.46	−0.34	−0.57	+0.01	−0.36	−0.37	−0.35	−2.4	−1.1
8	Berlin	B. D.+18° 2182	I	−0.88	−0.79	−0.49	−0.37	−0.61	+0.03	−0.34	−0.41	−0.34	−3.3	−2.1
8	Berlin	B. D.+17° 2092	I	−0.88	−0.79	+0.49	+0.35	+0.61	−0.41	−0.26	+0.43	−0.34	−2.2	−1.0
9	Berlin	B. D.+11° 2219	I	−1.10	−0.95	+0.02	+0.01	+0.02	−0.23	−0.44	+0.03	−0.20	−1.1	+0.4
9	Berlin	B. D.+11° 2222	I	−1.07	−0.92	−0.20	−0.08	−0.22	−0.12	−0.43	−0.08	−0.19	−2.0	−0.5
10	Greenwich	82 Leonis	IB	−0.89	−0.68	−0.62	−0.11	−0.63	+0.09	−0.44	−0.10	−0.03	−4.1	−2.9
10	Greenwich	83 Leonis	I	−1.05	−0.80	−0.39	−0.07	−0.40	−0.05	−0.48	−0.10	−0.04	+0.1	+1.5
10	Greenwich	τ Leonis	I	−0.96	−0.73	−0.54	−0.09	−0.55	+0.04	−0.46	−0.03	−0.03	−0.3	+1.0
11	Berlin	B. D.− 1° 2632	E	+0.75	+0.49	−0.72	+0.10	−0.73	+0.50	+0.23	+0.04	−0.15	−0.2	−1.0
11	Berlin	42 G. Virginis	E	+0.67	+0.44	−0.76	+0.12	−0.78	+0.50	+0.21	+0.02	−0.14	+0.5	−0.2
12	Berlin	49 Virginis	E	+1.01	+0.51	+0.27	−0.12	+0.29	+0.03	+0.46	−0.11	−0.40	+0.2	−0.8
29	Berlin	B. D.+20° 493	I	−0.88	−0.03	−0.26	+0.38	+0.46	+0.04	+0.32	+0.35	−0.63	−1.0	+0.2
29	Berlin	B. D.+20° 496	I	−0.90	−0.04	+0.24	−0.37	−0.44	−0.25	+0.28	−0.32	−0.65	+0.9	+2.1
29	Padua	ε Arietis	I	−0.78	−0.03	+0.34	−0.51	−0.61	−0.27	+0.22	−0.44	−0.57	+1.7	+2.8
29	Padua	ε Arietis	EB	+0.64	+0.03	+0.41	−0.63	−0.76	−0.18	−0.26	−0.55	+0.48	−0.8	−1.5
30	Berlin	B. D.+24° 595	I	−0.62	−0.10	+0.29	−0.74	−0.79	−0.26	+0.13	−0.67	−0.56	+0.8	+1.6
30	Berlin	B. D.+24° 603	I	−0.99	−0.16	+0.05	−0.13	−0.14	−0.15	+0.23	−0.11	−0.89	−1.0	+0.4
30	Berlin	B. D.+24° 602	I	−0.66	−0.11	+0.25	−0.72	−0.76	−0.25	+0.13	−0.66	−0.61	+0.2	+1.1
31	Berlin	B. D.+26° 764	I	−0.81	−0.30	−0.08	+0.61	+0.62	−0.05	+0.11	+0.60	−0.76	−2.7	−1.6
31	Berlin	B. D.+27° 712	I	−1.04	−0.38	0.00	−0.04	−0.04	−0.17	+0.12	−0.02	−0.97	−1.7	−0.2
31	Berlin	B. D.+27° 716	I	−1.02	−0.37	−0.02	+0.17	+0.17	−0.14	+0.12	+0.18	−0.95	−1.3	+0.1
31	Berlin	B. D.+27° 716	I	−1.03	−0.38	−0.02	+0.15	+0.15	−0.14	+0.12	+0.16	−0.96	−1.0	+0.4
Apr. 1	Berlin	B. D.+28° 930	I	−1.08	−0.71	−0.01	−0.07	−0.07	−0.20	+0.01	−0.06	−1.00	−0.9	+0.6
1	Berlin	B. D.+27° 895	I	−0.37	−0.24	+0.10	+0.94	+0.94	−0.06	0.00	+0.94	−0.34	+0.8	+1.3
1	Berlin	B. D.+28° 934	I	−0.84	−0.55	−0.07	−0.62	−0.62	−0.16	0.00	−0.61	−0.78	−0.1	+1.1
1	Berlin	B. D.+28° 941	I	−1.07	−0.70	+0.01	+0.12	+0.12	−0.19	+0.01	+0.13	−0.99	−0.9	+0.6
1	Berlin	B. D.+28° 940	I	−0.84	−0.55	−0.07	−0.62	−0.62	−0.17	0.00	−0.62	−0.78	+0.4	+1.6
1	Berlin	B. D.+27° 913	I	−0.82	−0.54	+0.07	+0.64	+0.64	−0.15	+0.01	+0.65	−0.76	−1.7	−0.6
1	Berlin	B. D.+27° 912	I	−0.63	−0.41	+0.09	+0.82	+0.82	−0.11	+0.01	+0.82	−0.58	−1.0	−0.1
1	Berlin	B. D.+27° 915	I	−0.63	−0.41	+0.09	+0.81	+0.81	−0.11	0.00	+0.82	−0.58	−0.3	+0.6
1	Berlin	B. D.+27° 933	I	−0.31	−0.21	+0.12	+0.96	+0.96	−0.04	0.00	+0.96	−0.29	−0.1	+0.3
1	Berlin	B. D.+28° 961	I	−1.08	−0.71	−0.01	−0.10	−0.10	−0.20	0.00	+0.09	−1.00	0.0	+1.5
1	Berlin	B. D.+28° 966	I	−1.07	−0.70	−0.02	−0.16	−0.16	−0.20	0.00	−0.15	−0.99	−0.3	+1.2
1	Berlin	B. D.+28° 982	I	−0.89	−0.62	−0.07	−0.50	−0.50	−0.12	−0.02	−0.48	−0.87	+1.4	+2.6
1	Berlin	B. D.+27° 960	I	−1.02	−0.67	+0.05	+0.34	+0.34	−0.20	0.00	+0.36	−0.94	+1.6	+3.0
1	Berlin	B. D.+27° 956	I	−0.52	−0.34	+0.12	+0.88	+0.88	−0.10	0.00	+0.89	−0.48	−1.0	−0.3
1	Berlin	B. D.+28° 989	I	−0.60	−0.40	−0.12	−0.81	−0.83	−0.11	0.00	−0.82	−0.56	+0.1	+0.9
2	Berlin	Anon.	I	−1.05	−0.84	−0.12	−0.30	−0.32	−0.18	−0.13	−0.30	−0.93	−0.7	+0.8
2	Berlin	B. D.+27° 1294	I	−0.95	−0.76	−0.18	−0.47	−0.51	−0.14	−0.12	−0.48	−0.84	−0.4	+0.9
2	Berlin	B. D.+27° 1293	I	−0.81	−0.65	−0.26	−0.64	−0.69	−0.08	−0.12	−0.64	−0.73	−1.0	+0.1
2	Berlin	B. D.+27° 1293	I	−0.77	−0.62	−0.26	−0.66	−0.71	−0.07	−0.09	−0.69	−0.69	+0.2	+1.3
2	Berlin	B. D.+27° 1296	I	−1.09	−0.87	−0.06	−0.14	−0.15	−0.20	−0.13	−0.14	−0.97	−1.5	0.0
2	Berlin	B. D.+27° 1292	I	−0.39	−0.31	+0.33	+0.86	+0.93	−0.17	−0.04	+0.92	−0.34	+1.9	+2.4
2	Berlin	B. D.+27° 1295	I	−0.43	−0.34	−0.34	−0.86	−0.92	+0.01	−0.05	−0.90	−0.38	+0.2	+0.8
3	Cape	ω^1 Cancri	I	−0.29	−0.26	+0.56	+0.78	+0.96	−0.26	−0.03	+0.84	−0.27	−1.1	−0.7
4	Berlin	B. D.+19° 2153	I	−1.10	−0.99	+0.11	+0.09	+0.14	−0.28	−0.34	+0.13	−0.80	+0.3	+1.8
4	Berlin	B. D.+19° 2170	I	−1.10	−0.99	−0.13	−0.10	−0.17	−0.18	−0.35	−0.11	−0.80	−1.1	+0.4
4	Berlin	B. D.+19° 2171	I	−1.06	−0.95	−0.25	−0.20	−0.32	−0.12	−0.36	−0.22	−0.77	0.0	+1.5
4	Berlin	B. D.+19° 2174	I	−1.09	−0.98	−0.17	−0.13	−0.21	−0.17	−0.36	−0.12	−0.79	−1.8	−0.3
7	Berlin	9 B. Virginis	I	−0.72	−0.53	+0.75	−0.07	+0.75	−0.50	−0.23	+0.07	−0.20	−0.2	+0.8
7	Berlin	B. D.− 0° 2507	I	−1.06	−0.78	+0.26	−0.03	+0.26	−0.34	−0.43	+0.06	−0.30	−0.6	+0.9
10	Berlin	B. D.−19° 3899	E	+1.02	+0.20	−0.03	+0.04	−0.05	+0.17	+0.36	0.00	−0.34	−3.3	−4.3
11	Berlin	C. D.−23° 12251	E	+0.99	−0.03	−0.07	+0.12	−0.14	+0.15	+0.29	+0.06	−0.52	−2.2	−3.2
11	Berlin	C. D.−23° 12264	E	+0.90	−0.03	+0.20	−0.37	+0.42	−0.02	+0.29	−0.38	−0.48	−3.3	−4.2
12	Berlin	C. D.−27° 10930	E	+0.97	−0.25	−0.01	+0.06	−0.06	+0.08	+0.19	+0.03	−0.70	+0.4	−0.6
28	Berlin	B. D.+27° 866	I	−0.94	−0.58	+0.05	+0.47	+0.47	−0.15	+0.02	+0.49	−0.76	−0.4	+0.9
29	Berlin	B. D.+27° 1213	I	−1.08	−0.79	+0.04	+0.10	+0.11	−0.21	−0.09	+0.13	−0.92	−1.0	+0.5
29	Berlin	B. D.+27° 1212	I	−0.96	−0.70	−0.15	−0.44	−0.46	−0.14	−0.09	−0.44	−0.82	0.0	+1.3
29	Berlin	B. D.+27° 1236	I	−1.00	−0.74	−0.14	−0.36	−0.39	−0.16	−0.11	−0.36	−0.86	−0.6	+0.8
30	Berlin	B. D.+24° 1777	I	−0.65	−0.55	+0.46	+0.66	+0.81	−0.30	+0.11	+0.76	−0.59	−0.9	0.0
30	Berlin	B. D.+24° 1783	I	−1.00	−0.85	+0.24	+0.34	+0.42	−0.28	−0.19	+0.39	−0.91	+0.4	+1.8
May 1	Berlin	γ Cancri	I	−1.00	−0.86	−0.31	−0.28	−0.42	−0.08	−0.30	−0.33	−0.90	−0.4	+1.0
1	Berlin	B. D.+21° 1914	I	−1.11	−0.96	+0.07	+0.06	+0.09	−0.16	−0.32	+0.09	−1.00	+1.4	+3.0
1	Berlin	B. D.+20° 2224	I	−0.99	−0.85	+0.34	+0.29	+0.45	−0.35	−0.26	+0.37	−0.89	−0.4	+1.0
1	Berlin	B. D.+20° 2228	I	−1.07	−0.92	+0.21	+0.18	+0.28	−0.31	−0.29	+0.23	−0.96	+2.5	+4.0
1	Berlin	B. D.+20° 2233	I	−0.97	−0.84	−0.39	−0.32	−0.50	−0.05	−0.32	−0.37	−0.87	−0.4	+1.0
1	Berlin	B. D.+20° 2232	I	−1.00	−0.86	+0.33	+0.27	+0.43	−0.33	−0.28	+0.36	−0.90	−0.6	+0.8

GROUP XIII—1891-1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1895, May	1	Padua	γ Cancri	I	−1.07	−0.96	−0.05	−0.04	−0.06	−0.17	−0.31	−0.03	−1.00	−0.8	+0.7
	1	Padua	γ Cancri	EB	+0.98	+0.87	−0.30	−0.28	−0.41	+0.29	+0.26	−0.36	+0.91	−1.5	−2.5
	2	Berlin	B.D.+15° 2114	I	−0.97	−0.87	+0.45	+0.22	+0.50	−0.41	−0.31	+0.32	−0.83	−1.7	−0.3
	2	Berlin	B.D.+15° 2117	I	−0.74	−0.67	−0.67	−0.33	−0.74	+0.11	−0.27	−0.43	−0.64	−1.8	−0.8
	2	Berlin	B.D.+15° 2118	I	−1.05	−0.95	+0.27	+0.13	+0.30	−0.32	−0.37	+0.20	−0.90	+1.5	+3.0
	3	Berlin	B.D.+10° 2176	I	−1.09	−0.97	−0.14	−0.03	−0.14	−0.15	−0.44	−0.04	−0.91	+0.2	+1.7
	4	Greenwich	τ Leonis	I	−1.09	−0.91	+0.04	0.00	+0.04	−0.23	−0.46	+0.03	−0.81	+0.3	+1.8
	5	Berlin	98 B. Virginis	I	−1.05	−0.73	−0.22	+0.06	−0.23	−0.08	−0.48	+0.05	−0.60	−1.0	+0.5
	5	Berlin	42 G. Virginis	I	−1.05	−0.73	−0.24	+0.06	−0.25	−0.08	−0.48	+0.05	−0.60	−0.8	+0.7
	5	Berlin	B.D.− 3° 3264	I	−1.07	−0.74	−0.12	+0.03	−0.12	−0.13	−0.47	+0.04	−0.61	−0.3	+1.2
	5	Berlin	B.D.− 3° 3267	I	−1.06	−0.73	+0.19	−0.05	+0.20	−0.30	−0.44	+0.04	−0.61	−0.1	+1.4
	5	Berlin	129 B. Virginis	I	−1.08	−0.75	0.00	0.00	0.00	−0.20	−0.48	+0.04	−0.62	−1.5	0.0
	5	Berlin	B.D.− 4° 3275	I	−1.03	−0.71	−0.31	+0.09	−0.32	−0.04	−0.48	+0.06	−0.59	0.0	+1.5
	5	Berlin	B.D.− 4° 3281	I	−1.05	−0.73	+0.21	−0.06	+0.22	−0.30	−0.44	+0.02	−0.60	+1.3	+2.8
	6	Berlin	B.D.−10° 3624	I	−1.02	−0.61	−0.27	+0.15	−0.31	−0.04	−0.45	+0.14	−0.48	−0.1	+1.4
	6	Berlin	B.D.−10° 3627	I	−1.02	−0.61	+0.27	−0.14	+0.30	−0.31	−0.41	−0.04	−0.48	−0.4	+1.1
	6	Cape	g Virginis	I	−0.46	−0.27	−0.80	+0.43	−0.90	+0.31	−0.30	+0.27	−0.21	−0.6	+0.1
	7	Berlin	B.D.−16° 3802	I	−1.04	−0.36	−0.07	+0.07	−0.10	−0.12	−0.41	+0.10	−0.20	−1.3	+0.2
	9	Greenwich	π Scorpii	E	+0.74	−0.01	−0.21	+0.66	−0.69	+0.25	+0.15	+0.59	−0.12	−0.2	−1.0
	28	Berlin	B.D.+21° 1866	I	−1.08	−0.93	−0.14	−0.14	−0.19	−0.17	−0.30	−0.13	−0.87	−0.7	+0.8
	28	Berlin	B.D.+21° 1868	I	−1.06	−0.91	−0.19	−0.18	−0.26	−0.13	+0.30	−0.20	−0.85	−0.6	+0.9
	29	Berlin	B.D.+16° 1975	I	−0.58	−0.52	+0.66	+0.55	+0.86	−0.42	−0.13	+0.59	−0.50	−1.5	−0.7
	30	Berlin	B.D.+11° 2217	I	−1.08	−0.97	−0.22	−0.06	−0.23	−0.16	−0.44	−0.09	−0.97	0.0	+1.5
	30	Berlin	B.D.+11° 2221	I	−1.11	−1.00	+0.06	+0.02	+0.06	−0.26	−0.43	+0.05	−1.00	−0.2	+1.4
	30	Berlin	B.D.+11° 2223	I	−1.10	−0.99	+0.13	+0.03	+0.13	+0.14	−0.43	+0.10	−0.99	+1.3	+2.9
	30	Berlin	45 Leonis	I	−0.67	−0.60	+0.79	+0.19	+0.81	−0.49	−0.18	+0.37	−0.60	+0.2	+1.2
	31	Berlin	B.D.+ 5° 2467	I	−1.05	−0.88	−0.31	−0.01	−0.31	−0.06	−0.47	−0.04	−0.94	+0.5	+2.0
June	9	Berlin	248 B. Sagittarii	E	+0.83	−0.71	+0.21	+0.34	−0.40	−0.04	−0.16	+0.37	−0.46	+2.7	+1.8
	12	Berlin	B.D.−15° 6103	E	+0.08	−0.09	+0.93	+0.37	−1.00	−0.40	−0.13	+0.57	−0.08	+1.2	+1.1
	12	Berlin	B.D.−15° 6109	E	+0.85	−0.96	+0.26	+0.11	−0.28	−0.11	−0.43	+0.15	−0.88	+3.4	+2.5
	12	Berlin	B.D.−15° 6111	E	+0.81	−0.91	+0.39	+0.15	−0.42	−0.16	−0.43	+0.23	−0.84	+2.5	+1.6
	13	Berlin	B.D.−10° 5973	E	+0.89	−0.97	+0.04	+0.01	−0.04	0.00	−0.46	+0.02	−0.98	+3.6	+2.6
	13	Berlin	B.D.−10° 5974	E	+0.77	−0.83	+0.50	+0.09	−0.51	−0.21	−0.43	+0.20	−0.84	+2.3	+1.4
	13	Berlin	65 Aquarii	E	+0.82	−0.89	−0.38	−0.07	+0.39	−0.18	−0.37	−0.15	−0.90	+1.5	+0.6
	15	Berlin	B.D.+ 0° 2	E	+0.82	−0.80	+0.39	−0.10	−0.40	−0.18	−0.46	−0.01	−0.90	+2.5	+1.6
	15	Berlin	B.D.+ 0° 8	E	+0.43	−0.42	−0.85	+0.23	+0.88	+0.42	−0.12	+0.02	−0.48	−0.4	−0.9
	16	Berlin	B.D.+ 6° 114	E	+0.54	−0.44	+0.74	−0.36	−0.82	−0.34	−0.35	−0.19	−0.56	+2.6	+2.0
	16	Berlin	B.D.+ 6° 115	E	+0.90	−0.74	−0.19	+0.09	+0.21	+0.13	−0.43	+0.02	−0.94	+1.1	+0.1
	26	Hamburg	α Leonis	I	−1.03	−0.93	+0.35	+0.11	+0.37	−0.37	−0.36	+0.24	−0.73	−1.0	+0.5
	26	Hamburg	α Leonis	EB	+1.07	+0.97	+0.23	+0.07	+0.25	+0.12	+0.43	+0.08	+0.77	+0.4	−0.8
	26	Göttingen	α Leonis	I	−1.02	−0.92	+0.37	+0.12	+0.39	−0.37	−0.35	+0.25	−0.73	−1.3	+0.2
	26	Pola	α Leonis	I	−0.99	−0.90	+0.42	+0.14	+0.44	−0.38	−0.34	+0.28	−0.71	−0.2	+1.3
	26	Greenwich	α Leonis	I	−0.94	−0.85	+0.50	+0.16	+0.53	−0.41	−0.31	+0.29	−0.67	−1.8	−0.4
	26	Greenwich	α Leonis	EB	+1.03	+0.93	+0.34	+0.11	+0.36	+0.06	+0.43	+0.17	+0.73	−0.4	−1.5
	27	Berlin	B.D.+ 6° 2387	I	−0.87	−0.76	+0.62	+0.03	+0.62	−0.47	−0.29	+0.20	−0.73	−1.5	−0.2
July	2	Berlin	C.D.−23° 12194	I	−0.75	−0.12	+0.28	−0.61	+0.67	−0.29	−0.20	−0.50	−0.56	−1.1	0.0
	2	Berlin	C.D.−23° 12202	I	−0.85	−0.13	+0.24	−0.51	+0.56	−0.28	−0.23	−0.40	−0.62	−1.8	−0.5
	2	Berlin	C.D.−23° 12208	I	−0.93	−0.15	+0.17	−0.37	+0.41	−0.26	−0.27	−0.32	−0.68	−2.7	−1.3
	9	Padua	δ Capricor.	IB	−0.87	+0.96	+0.17	+0.07	−0.18	−0.07	+0.39	+0.13	+0.54	−2.2	−0.9
	9	Padua	δ Capricor.	E	+0.88	−0.95	−0.22	−0.09	+0.24	+0.12	−0.38	−0.18	−0.53	+1.6	+0.6
	14	Berlin	B.D.+ 9° 148	E	+0.47	−0.26	−0.73	+0.49	+0.87	+0.53	−0.13	+0.28	−0.49	−0.8	−1.3
	14	Berlin	B.D.+ 9° 146	E	+0.89	−0.49	+0.27	−0.18	−0.32	−0.09	−0.45	−0.13	−0.93	+3.8	+2.8
	14	Berlin	B.D.+10° 161	E	+0.89	−0.49	+0.25	−0.18	−0.31	−0.08	−0.47	−0.13	−0.93	+3.8	+2.8
	15	Berlin	B.D.+15° 303	E	+0.95	−0.32	−0.12	+0.13	+0.17	+0.15	−0.39	+0.08	−0.92	+2.7	+1.7
	15	Berlin	B.D.+15° 304	E	+0.87	−0.29	−0.28	+0.32	+0.42	+0.23	−0.36	+0.22	−0.85	+1.4	+0.4
	16	Berlin	B.D.+19° 433	E	+0.84	−0.14	−0.25	+0.44	+0.50	+0.25	−0.27	+0.34	−0.75	+2.8	+1.9
	16	Berlin	47 Arietis	E	+0.73	−0.12	−0.32	+0.59	+0.67	+0.29	−0.22	+0.48	−0.64	+1.8	+1.0
	16	Greenwich	47 Arietis	E	+0.85	−0.14	−0.24	+0.44	+0.50	+0.20	−0.26	+0.35	−0.76	+2.6	+1.7
	17	Hamburg	η Tauri	E	+1.01	+0.04	0.00	0.00	0.00	+0.13	−0.26	−0.01	−0.76	+3.0	+1.9
	17	Berlin	27 Tauri	E	+0.75	+0.03	−0.19	+0.64	+0.66	+0.23	−0.16	+0.55	−0.57	+1.5	+0.7
	17	Berlin	28 Tauri	E	+0.93	+0.04	−0.11	+0.36	+0.38	+0.19	−0.21	+0.31	−0.71	+2.4	+1.4
	17	Berlin	B.D.+24° 589	E	+0.72	+0.03	+0.18	−0.68	−0.70	−0.07	−0.21	−0.61	−0.55	+1.7	+0.9
	18	Berlin	B.D.+26° 759	E	+0.84	+0.13	−0.01	+0.57	+0.57	+0.19	−0.08	+0.53	−0.57	+1.9	+1.0
	30	Cape	48 B. Scorpii	I	−0.94	−0.15	+0.06	−0.28	+0.29	−0.16	−0.20	−0.23	−0.91	−0.6	+0.8
Aug.	7	Greenwich	81 Aquarii	E	+0.85	−0.93	−0.34	−0.01	+0.34	+0.18	−0.40	−0.13	−0.43	0.0	−0.9
	7	Greenwich	82 Aquarii	IB	−0.54	+0.59	+0.80	+0.02	−0.80	−0.37	+0.19	+0.26	+0.28	−2.2	−1.4
	10	Berlin	B.D.+ 8° 158	E	+0.88	−0.61	−0.26	+0.15	+0.30	+0.18	−0.40	+0.06	−0.87	+1.4	+0.4
	10	Berlin	180 B. Piscium	E	+0.70	−0.48	+0.57	−0.34	−0.66	−0.26	−0.40	−0.20	−0.69	+2.0	+1.2
	12	Greenwich	B.D.+18° 325	E	+0.92	−0.30	+0.12	−0.17	−0.21	−0.01	−0.37	−0.16	−0.98	+1.1	−0.1
	13	Berlin	B.D.+23° 462	E	+0.91	+0.02	+0.14	−0.37	−0.40	0.00	−0.26	−0.36	−0.87	+2.5	+1.5

GROUP XIII—1891-1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1895, Aug.	13	Berlin	B. D. +23° 463	E	+0.96	+0.02	+0.10	−0.26	−0.28	+0.05	−0.27	−0.26	−0.92	+3.2	+2.1
	13	Berlin	B. D. +23° 465	E	+0.99	+0.02	+0.05	−0.13	−0.14	+0.08	−0.27	−0.06	−0.95	+2.3	+1.2
	13	Berlin	B. D. +23° 468	E	+0.73	+0.01	−0.24	+0.65	+0.69	+0.25	−0.17	+0.55	−0.70	+1.4	+0.6
	13	Berlin	B. D. +23° 467	E	+0.93	+0.02	+0.13	−0.36	−0.38	+0.02	−0.27	−0.29	−0.89	+2.1	+1.1
	13	Berlin	B. D. +23° 469	E	+0.97	+0.02	+0.09	−0.24	−0.26	+0.06	−0.28	−0.24	−0.93	+3.2	+2.1
	16	Berlin	B. D. +27° 1133	E	+1.06	+0.64	−0.06	−0.15	−0.16	+0.20	+0.06	−0.18	−0.62	+1.6	+0.4
Sept.	2	Berlin	B. D. −15° 6119	I	−0.65	+0.71	+0.66	+0.20	−0.69	−0.30	+0.24	+0.40	−0.19	−0.1	+0.9
	2	Greenwich	ι Aquarii	I	−0.84	+0.91	−0.35	−0.09	+0.36	+0.13	+0.43	−0.18	−0.25	−1.3	0.0
	5	Berlin	B. D. + 1° 10	E	+0.83	−0.81	−0.38	+0.12	+0.39	+0.20	−0.37	−0.01	−0.35	+0.8	−0.2
	5	Berlin	B. D. + 2° 16	E	+0.87	−0.85	+0.23	−0.08	−0.24	0.00	−0.50	−0.03	−0.37	+2.1	+1.1
	6	Berlin	60 Piscium	E	+0.51	−0.44	−0.73	+0.40	+0.83	−0.11	−0.16	+0.16	−0.29	+0.3	−0.3
	6	Berlin	62 Piscium	E	+0.75	−0.65	+0.50	−0.27	−0.57	−0.23	−0.43	−0.13	−0.42	+3.4	+2.5
	6	Berlin	B. D. + 6° 111	E	+0.55	−0.48	+0.70	−0.38	−0.80	−0.34	−0.36	−0.19	−0.31	+1.8	+1.2
	6	Padua	62 Piscium	IB	−0.69	+0.60	+0.57	−0.32	−0.65	−0.32	+0.27	−0.13	+0.39	−1.7	−0.6
	6	Padua	62 Piscium	E	+0.79	−0.69	+0.44	−0.25	−0.50	−0.20	−0.46	−0.12	−0.44	+1.7	+0.8
	9	Berlin	B. D. +21° 413	E	+0.56	−0.08	−0.33	+0.76	+0.82	+0.30	−0.14	+0.63	−0.54	+0.4	−0.3
	9	Berlin	B. D. +21° 416	E	+0.82	−0.12	−0.21	+0.49	+0.53	+0.23	−0.24	+0.40	−0.80	+1.9	+0.9
	9	Berlin	B. D. +21° 427	E	+0.84	−0.12	−0.19	+0.46	+0.50	+0.22	−0.24	+0.38	−0.82	+1.4	+0.4
	9	Berlin	B. D. +22° 463	E	+0.93	−0.13	+0.11	−0.29	−0.31	+0.01	−0.30	−0.28	−0.90	+2.6	+1.5
	9	Berlin	B. D. +22° 466	E	+0.94	−0.13	+0.11	−0.26	−0.28	+0.02	−0.30	−0.25	−0.91	+2.9	+1.8
	9	Berlin	B. D. +22° 468	E	+0.76	−0.11	+0.23	−0.57	−0.61	−0.10	−0.24	−0.50	−0.74	+2.9	+2.0
	9	Berlin	B. D. +22° 469	E	+0.98	−0.14	−0.03	+0.07	+0.07	+0.12	−0.30	+0.02	−0.95	+3.1	+2.0
	10	Berlin	B. D. +24° 613	E	+0.94	+0.08	+0.07	−0.36	−0.37	+0.05	−0.21	−0.36	−0.92	+1.7	+0.6
	10	Berlin	B. D. +25° 667	E	+0.95	+0.08	+0.06	−0.33	−0.34	+0.06	−0.21	−0.32	−0.93	+2.6	+1.5
	10	Berlin	B. D. +24° 616	E	+1.01	+0.09	−0.02	+0.09	+0.09	+0.15	−0.20	+0.06	−0.99	+3.8	+2.6
	10	Berlin	B. D. +25° 671	E	+0.97	+0.09	+0.05	−0.26	−0.27	+0.07	−0.21	−0.27	−0.95	+2.2	+1.0
	10	Berlin	B. D. +24° 617	E	+0.82	+0.07	−0.10	+0.56	+0.57	+0.22	−0.18	+0.51	−0.80	+2.0	+1.0
	10	Berlin	B. D. +25° 677	E	+0.51	+0.04	+0.15	−0.85	−0.87	−0.09	−0.12	−0.80	−0.50	+2.4	+1.8
	10	Berlin	B. D. +25° 678	E	+0.54	+0.05	+0.13	−0.84	−0.86	−0.09	−0.14	−0.78	−0.52	+2.5	+1.9
	10	Berlin	B. D. +25° 681	E	+0.98	+0.09	+0.03	−0.22	−0.22	+0.08	−0.21	−0.23	−0.96	+2.4	+1.2
	10	Berlin	B. D. +25° 682	E	+0.98	+0.09	+0.04	−0.25	−0.26	+0.09	−0.20	−0.26	−0.96	+2.8	+1.6
	10	Berlin	B. D. +25° 685	E	+0.88	+0.08	+0.07	−0.49	−0.50	+0.03	−0.18	−0.46	−0.86	+2.4	+1.3
	11	Berlin	B. D. +27° 733	E	+0.99	+0.30	+0.03	+0.28	+0.28	+0.17	−0.08	+0.25	−0.95	+1.4	+0.2
	11	Berlin	B. D. +27° 738	E	+0.99	+0.30	+0.03	+0.28	+0.28	+0.17	−0.09	+0.25	−0.95	+0.4	−0.8
	15	Greenwich	83 Cancri	E	+1.11	+0.92	+0.15	+0.08	+0.17	+0.18	+0.38	+0.08	−0.57	+2.7	+1.4
	29	Hamburg	δ Capricor.	I	−0.90	+0.93	+0.08	+0.03	−0.09	−0.06	+0.39	+0.08	−0.75	−1.4	0.0
	29	Prague	δ Capricor.	I	−0.89	+0.92	−0.11	−0.04	+0.11	+0.06	+0.42	−0.02	−0.74	−2.3	−0.9
	29	Greenwich	δ Capricor.	I	−0.87	+0.90	+0.24	+0.09	−0.26	−0.12	+0.37	+0.18	−0.73	−1.5	−0.1
	29	Greenwich	δ Capricor.	EB	+0.90	−0.93	−0.09	−0.03	+0.09	+0.06	−0.40	−0.08	+0.75	+0.1	−1.0
	29	Berlin	B. D. −17° 6363	I	−0.89	+0.92	−0.16	−0.06	+0.17	+0.04	+0.43	−0.09	−0.74	−3.1	−1.7
	29	Berlin	δ Capricor.	I	−0.90	+0.93	−0.02	−0.01	+0.02	+0.02	+0.45	0.00	−0.75	−4.0	−2.6
	29	Berlin	B. D. −16° 5946	I	−0.84	+0.86	−0.35	−0.11	+0.37	+0.12	+0.41	−0.21	−0.70	−3.3	−2.0
	29	Berlin	δ Capricor.	EB	+0.84	−0.86	−0.34	−0.12	+0.36	+0.17	−0.43	−0.23	+0.70	+2.3	+1.3
	30	Berlin	B. D. −11° 5842	I	−0.87	+0.97	−0.17	−0.02	+0.17	+0.08	+0.46	−0.08	−0.60	−2.9	−1.5
	30	Berlin	58 Aquarii	I	−0.87	+0.97	−0.17	−0.02	+0.17	+0.08	+0.47	−0.08	−0.60	−3.2	−1.8
	30	Greenwich	58 Aquarii	I	−0.89	+0.98	+0.12	+0.01	−0.12	−0.07	+0.43	+0.08	−0.60	−2.7	−1.3
Oct.	1	Berlin	282 B. Aquarii	I	−0.88	+0.98	+0.17	+0.02	−0.17	−0.09	+0.51	+0.07	−0.37	−2.5	−1.1
	1	Berlin	B. D. − 5° 5963	I	−0.83	+0.92	+0.37	+0.03	−0.37	−0.18	+0.49	+0.10	−0.34	−1.5	−0.2
	4	Berlin	235 B. Piscium	E	+0.74	−0.52	+0.46	−0.38	−0.60	−0.22	−0.40	−0.22	−0.22	+2.4	+1.5
	4	Berlin	B. D. +11° 175	E	+0.81	−0.57	+0.36	−0.32	−0.48	−0.17	−0.42	−0.20	−0.24	+2.5	+1.5
	7	Berlin	η Tauri	E	+0.46	−0.02	−0.20	+0.86	+0.89	+0.24	−0.08	+0.74	−0.36	−0.5	−1.1
	7	Berlin	24 Tauri	E	+0.57	−0.03	−0.18	+0.80	+0.82	+0.24	−0.11	+0.68	−0.46	+0.4	−0.3
	7	Berlin	B. D. +23° 531	E	+0.64	−0.03	−0.17	+0.74	+0.76	+0.23	−0.13	+0.64	−0.51	−0.2	−1.0
	7	Berlin	B. D. +23° 540	E	+0.95	−0.05	−0.06	+0.26	+0.27	+0.17	−0.23	+0.22	−0.76	+0.6	−0.5
	7	Berlin	B. D. +23° 549	E	+0.91	−0.05	−0.08	+0.38	+0.39	+0.18	−0.22	+0.31	−0.73	+1.3	+0.2
	7	Berlin	105 B. Tauri	E	+0.92	−0.05	−0.08	+0.36	+0.37	+0.19	−0.23	+0.31	−0.73	+1.5	+0.4
	7	Berlin	B. D. +23° 560	E	+0.89	−0.04	−0.09	+0.43	+0.44	+0.19	−0.22	+0.36	−0.71	+0.9	−0.1
	7	Berlin	B. D. +23° 561	E	+0.85	−0.04	−0.11	+0.50	+0.51	+0.20	−0.21	+0.42	−0.68	+1.3	+0.3
	7	Berlin	B. D. +23° 567	E	+0.60	−0.03	−0.16	+0.77	+0.79	+0.23	−0.12	+0.67	−0.48	−0.2	−0.9
	7	Berlin	B. D. +24° 578	E	+0.87	−0.04	−0.09	+0.45	+0.46	+0.19	−0.22	+0.36	−0.70	+0.6	−0.4
	7	Berlin	B. D. +24° 595	E	+0.97	−0.05	+0.04	−0.20	−0.20	+0.05	−0.24	−0.20	−0.77	−2.2	−3.4
	7	Berlin	B. D. +24° 598	E	+0.96	−0.05	+0.04	−0.22	−0.22	+0.02	−0.23	−0.22	−0.77	+2.6	+1.4
	9	Berlin	406 B. Tauri	E	+1.05	+0.42	0.00	0.00	0.00	+0.17	+0.01	−0.03	−0.97	−2.5	−3.8
	10	Berlin	B. D. +27° 1230	E	+0.97	+0.56	+0.19	+0.36	+0.41	+0.12	+0.10	+0.37	−0.91	−0.9	−2.1
	11	Berlin	B. D. +24° 1785	E	+0.23	+0.17	+0.67	+0.72	+0.98	−0.16	+0.08	+0.90	−0.20	0.0	−0.3
	11	Berlin	B. D. +24° 1783	E	+1.05	+0.76	−0.18	−0.20	−0.27	+0.26	+0.21	−0.28	−0.93	+0.1	−1.2
	11	Berlin	B. D. +24° 1800	E	+0.96	+0.70	+0.33	+0.35	+0.47	+0.07	+0.23	−0.40	−0.85	+1.0	−0.2
	28	Berlin	B. D. − 8° 5980	I	−0.90	+1.00	0.00	0.00	0.00	−0.03	+0.47	+0.01	−0.79	−3.7	−2.2
	28	Berlin	82 Aquarii	I	−0.90	+1.00	−0.07	0.00	+0.07	+0.01	+0.47	+0.01	−0.79	−3.2	−1.7
	29	Berlin	B. D. − 2° 6007	I	−0.67	+0.73	−0.65	+0.15	+0.67	+0.30	+0.43	−0.07	−0.48	−4.8	−3.7

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1895, Oct. 29	Berlin	B. D. − 2° 6013	I	−0.88	+0.96	+0.12	−0.03	−0.12	−0.06	+0.46	+0.03	−0.63	−2.7	−1.3
31	Berlin	B. D. + 8° 158	I	−0.88	+0.76	−0.20	+0.14	+0.24	+0.06	+0.47	+0.08	−0.28	−2.7	−1.3
31	Berlin	180 B. Piscium	I	−0.65	+0.55	+0.57	−0.40	−0.70	−0.34	+0.25	−0.17	−0.21	−2.2	−1.1
31	Berlin	B. D. + 8° 177	I	−0.33	+0.28	−0.74	+0.56	+0.93	+0.40	+0.26	+0.29	−0.10	−3.3	−2.8
31	Berlin	210 B. Piscium	I	−0.80	+0.69	−0.38	+0.29	+0.48	+0.18	+0.43	+0.17	−0.26	−0.7	+0.6
Nov. 1	Berlin	B. D. +15° 290	I	−0.94	+0.56	−0.03	+0.02	+0.05	−0.04	+0.42	+0.06	−0.02	−3.7	−2.2
3	Greenwich	19 Tauri	E	+0.95	−0.20	−0.04	+0.22	+0.22	+0.14	−0.23	+0.16	−0.33	−0.4	−1.6
3	Greenwich	20 Tauri	E	+0.67	−0.14	−0.14	+0.72	+0.73	+0.22	−0.14	+0.60	+0.59	−1.1	−1.9
10	Pola	ρ Leonis	IB	−1.08	−0.99	0.00	0.00	0.00	−0.21	−0.43	+0.09	+0.95	−0.4	+1.3
10	Pola	ρ Leonis	E	+1.05	+0.96	−0.25	−0.02	−0.25	+0.31	+0.40	−0.15	−0.92	−0.7	−2.0
10	Berlin	B. D. +10° 2147	E	+1.11	+0.99	−0.04	0.00	−0.04	+0.15	−0.27	−0.05	−0.95	+1.4	+0.1
10	Berlin	45 Leonis	E	+1.02	+0.91	−0.40	+0.04	−0.40	+0.04	−0.28	−0.21	−0.87	+0.8	−0.5
25	Berlin	B. D. − 3° 5638	I	−0.72	+0.80	+0.56	−0.10	−0.57	−0.28	+0.32	+0.14	−0.75	−1.2	0.0
27	Göttingen	62 Piscium	I	−0.83	+0.82	−0.34	+0.23	+0.41	+0.16	+0.46	+0.10	−0.71	−0.1	+1.2
27	Göttingen	δ Piscium	I	−0.88	+0.86	+0.24	−0.16	−0.29	−0.17	+0.41	−0.04	−0.75	−2.0	−0.5
27	Pola	δ Piscium	I	−0.92	+0.90	+0.04	−0.02	−0.04	−0.06	+0.45	+0.01	−0.78	−2.9	−1.4
28	Berlin	B. D. +13° 250	I	−0.71	+0.51	+0.45	−0.46	−0.64	−0.30	+0.27	−0.25	−0.41	−2.3	−1.1
28	Berlin	B. D. +13° 267	I	−0.93	+0.67	+0.06	−0.07	−0.09	−0.09	+0.40	0.00	−0.54	−3.2	−1.6
29	Berlin	B. D. +18° 319	I	−0.86	+0.42	+0.21	−0.36	−0.42	−0.21	+0.32	−0.23	−0.30	−1.6	−0.2
30	Berlin	B. D. +21° 416	I	−0.96	+0.32	−0.01	+0.04	+0.04	−0.06	+0.31	+0.06	+0.03	−3.9	−2.3
30	Berlin	B. D. +21° 427	I	−0.96	+0.32	+0.01	−0.03	−0.03	−0.08	+0.30	0.00	+0.03	−4.0	−2.4
30	Berlin	B. D. +22° 466	I	−0.58	+0.19	+0.25	−0.76	−0.80	−0.27	+0.16	−0.61	+0.02	−6.1	−5.1
30	Berlin	B. D. +22° 469	I	−0.83	+0.28	+0.16	−0.48	−0.51	−0.21	+0.24	−0.36	+0.03	−2.2	−0.8
Dec. 6	Berlin	80 Cancri	E	+0.64	+0.52	−0.75	−0.33	−0.82	+0.41	+0.15	−0.61	−0.56	+0.6	−0.2
10	Greenwich	ψ Virginis	E	+0.36	+0.32	−0.75	+0.56	−0.94	+0.49	+0.05	+0.23	−0.31	+0.4	−0.1
28	Padua	20 Tauri	I	−0.76	+0.24	−0.10	+0.63	+0.63	+0.07	+0.21	+0.56	−0.45	−4.0	−2.7
29	Berlin	B. D. +26° 750	I	−0.92	0.00	+0.03	+0.38	+0.38	−0.06	+0.12	+0.39	−0.27	−1.9	−0.4
29	Berlin	B. D. +26° 752	I	−0.95	0.00	+0.04	+0.32	+0.32	−0.08	+0.11	+0.35	−0.28	−2.0	−0.4
29	Berlin	B. D. +26° 764	I	−0.98	0.00	+0.03	+0.19	+0.19	−0.09	+0.11	+0.21	−0.28	−5.0	−3.3
29	Berlin	B. D. +27° 716	I	−0.95	0.00	−0.04	−0.31	−0.31	−0.14	+0.09	−0.26	−0.28	−4.4	−2.8
1896, Jan. 7	Cape	ι Virginis	E	+1.06	+0.86	+0.17	−0.19	+0.26	+0.11	+0.45	−0.13	−0.97	−0.1	−1.5
8	Berlin	B. D. −19° 3870	E	+0.84	+0.64	−0.31	+0.56	−0.64	+0.39	+0.24	+0.36	−0.75	+0.4	−0.7
8	Berlin	B. D. −19° 3869	E	+0.92	+0.70	+0.25	−0.47	+0.53	−0.01	+0.35	−0.37	−0.82	+0.6	−0.6
8	Berlin	B. D. −19° 3879	E	+0.74	+0.56	−0.35	+0.64	−0.73	+0.40	+0.20	+0.42	−0.67	−0.4	−1.4
19	Padua	14 Piscium	I	−0.68	+0.76	+0.62	−0.19	−0.65	−0.32	+0.27	+0.16	−0.61	+0.1	+1.3
21	Berlin	B. D. + 8° 153	I	−0.37	+0.35	−0.71	+0.57	+0.91	+0.40	+0.28	+0.25	+0.41	−3.8	−3.2
21	Berlin	B. D. + 9° 116	I	−0.89	+0.84	+0.17	−0.14	−0.22	−0.13	+0.41	−0.02	−0.98	−3.1	−1.6
22	Santiago	ι Arietis	I	−0.49	+0.40	+0.46	−0.71	−0.85	−0.34	+0.15	−0.53	−0.55	+1.1	+1.9
24	Berlin	B. D. +22° 473	I	−0.89	+0.32	−0.09	+0.35	+0.36	+0.03	+0.28	+0.32	−0.81	−2.8	−1.3
24	Berlin	B. D. +22° 475	I	−0.96	+0.34	−0.01	+0.02	+0.02	−0.07	+0.29	+0.05	−0.87	−5.0	−3.4
24	Berlin	B. D. +22° 475	I	−0.96	+0.34	+0.01	+0.02	−0.02	−0.08	+0.29	+0.01	−0.87	−5.8	−4.2
24	Berlin	B. D. +22° 480	I	−0.52	+0.18	−0.20	+0.81	+0.84	+0.18	+0.18	+0.69	−0.47	−3.1	−2.2
24	Berlin	B. D. +22° 482	I	−0.67	+0.24	−0.17	+0.69	+0.71	+0.13	+0.21	+0.60	−0.61	−3.6	−2.5
24	Berlin	B. D. +23° 454	I	−0.92	+0.33	+0.06	−0.25	−0.26	−0.14	+0.27	−0.17	−0.84	−5.0	−3.4
24	Berlin	B. D. +23° 457	I	−0.36	+0.13	−0.20	+0.91	+0.93	+0.20	+0.10	+0.77	−0.32	−0.8	−0.2
24	Berlin	B. D. +23° 469	I	−0.59	+0.21	−0.16	+0.77	+0.79	+0.14	+0.18	+0.67	−0.53	−3.5	−2.5
24	Berlin	B. D. +23° 470	I	−0.56	+0.20	+0.16	−0.80	−0.82	−0.25	+0.16	−0.80	−0.50	−0.6	+0.4
26	Berlin	B. D. +27° 771	I	−0.73	−0.12	+0.17	+0.67	+0.69	−0.06	+0.05	+0.71	−0.40	−2.8	−1.6
26	Berlin	B. D. +27° 778	I	−0.96	−0.15	−0.09	−0.33	−0.34	−0.14	+0.03	−0.30	−0.53	−4.2	−2.6
26	Berlin	B. D. +27° 783	I	−1.00	−0.16	−0.06	−0.20	−0.21	−0.15	+0.03	−0.17	−0.55	−4.7	−3.0
26	Santiago	116 B. Aurigæ	I	−0.96	−0.09	−0.12	−0.35	−0.37	−0.15	+0.02	−0.34	−0.52	−1.4	+0.2
27	Santiago	25 Geminor.	I	−0.91	−0.28	+0.28	+0.44	+0.52	−0.21	−0.08	+0.54	−0.32	−1.3	+0.3
27	Berlin	B. D. +27° 1066	I	−0.97	−0.31	+0.17	+0.33	+0.37	−0.17	−0.05	+0.40	−0.38	−4.3	−2.6
27	Berlin	B. D. +27° 1089	I	−1.03	−0.33	+0.06	+0.11	+0.12	−0.15	−0.07	+0.15	−0.40	−4.3	−2.5
27	Berlin	B. D. +27° 1090	I	−0.41	−0.13	−0.43	−0.82	−0.92	−0.01	−0.02	−0.91	−0.16	−2.7	−2.0
28	Berlin	B. D. +25° 1644	I	−0.85	−0.43	−0.39	−0.46	−0.60	−0.04	−0.16	−0.54	−0.16	−3.4	−1.9
28	Berlin	B. D. +25° 1659	I	−1.03	−0.52	−0.17	−0.19	−0.26	−0.14	−0.19	−0.29	−0.19	−4.9	−3.1
28	Berlin	B. D. +25° 1709	I	−0.89	−0.45	−0.37	−0.38	−0.53	−0.05	−0.20	−0.46	−0.17	−3.5	−2.0
31	Cape	ρ Leonis	E	+0.98	+0.85	+0.45	0.00	+0.45	0.00	+0.45	+0.15	−0.40	+2.7	+1.4
Feb. 19	Berlin	B. D. +17° 339	I	−0.91	+0.63	+0.10	−0.18	−0.21	−0.12	+0.36	−0.08	−0.96	−1.8	−0.2
19	Berlin	B. D. +17° 346	I	−0.89	+0.61	−0.14	+0.27	+0.30	+0.06	+0.38	+0.23	−0.94	−0.9	+0.7
20	Berlin	B. D. +21° 403	I	−0.27	+0.13	+0.30	−0.92	−0.97	−0.31	+0.04	−0.69	−0.28	−0.3	+0.2
20	Berlin	B. D. +22° 438	I	−0.92	+0.45	+0.06	−0.21	−0.22	−0.12	+0.29	−0.14	−0.97	−2.9	−1.3
20	Berlin	B. D. +22° 441	I	−0.85	+0.41	+0.12	−0.45	−0.46	−0.19	+0.25	−0.31	−0.89	−0.9	+0.6
20	Berlin	B. D. +22° 446	I	−0.94	+0.46	−0.03	+0.13	+0.13	−0.03	+0.31	+0.14	−0.99	−2.9	−1.2
20	Berlin	B. D. +22° 453	I	−0.82	+0.40	+0.12	−0.49	−0.51	−0.20	+0.24	−0.37	−0.86	−1.3	+0.2
20	Berlin	B. D. +22° 455	I	−0.95	+0.46	−0.01	+0.03	+0.03	−0.06	+0.30	+0.06	−1.00	−3.3	−1.6
20	Berlin	B. D. +22° 457	I	−0.82	+0.40	+0.12	−0.48	−0.50	−0.20	+0.24	−0.36	−0.86	−0.6	+0.9
21	Berlin	B. D. +24° 598	I	−0.70	+0.18	−0.03	+0.69	+0.69	+0.07	+0.17	+0.64	−0.71	−2.7	−1.4
21	Berlin	B. D. +25° 656	I	−0.70	+0.18	+0.03	−0.71	−0.71	−0.20	+0.12	−0.60	−0.71	−0.4	+0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1896, Feb. 21	Berlin	B. D. +25° 674	I	−0.96	+0.25	0.00	−0.14	−0.14	−0.13	+0.20	−0.08	−0.97	−3.4	−1.7
21	Berlin	B. D. +25° 677	I	−0.96	+0.25	0.00	+0.17	+0.17	−0.06	+0.20	+0.19	−0.97	−3.4	−1.7
21	Berlin	B. D. +25° 678	I	−0.91	+0.24	0.00	−0.34	−0.34	−0.14	+0.18	−0.28	−0.92	−1.4	+0.2
22	Berlin	B. D. +27° 702	I	−0.95	+0.03	+0.05	+0.31	+0.32	−0.09	+0.10	+0.36	−0.87	−1.9	−0.2
22	Berlin	B. D. +27° 712	I	−0.88	+0.03	+0.09	+0.46	+0.47	−0.06	+0.09	+0.49	−0.81	−1.5	+0.1
22	Berlin	Anon.	I	−0.99	+0.03	−0.02	−0.12	−0.12	−0.13	+0.09	−0.08	−0.91	−3.0	−1.3
22	Berlin	B. D. +27° 716	I	−0.73	+0.02	+0.13	+0.67	+0.68	−0.03	+0.07	+0.69	−0.67	−2.6	−1.3
22	Berlin	B. D. +27° 716	I	−0.72	+0.02	+0.13	+0.69	+0.70	−0.03	+0.07	+0.71	−0.66	−2.0	−0.7
22	Berlin	B. D. +27° 717	I	−0.99	+0.03	−0.03	−0.16	−0.16	−0.14	+0.10	−0.12	−0.91	−3.2	−1.5
22	Berlin	B. D. +27° 722	I	−0.97	+0.03	−0.05	−0.25	−0.26	−0.14	+0.08	−0.20	−0.89	−2.0	−0.3
22	Berlin	B. D. +27° 731	I	−0.91	+0.03	+0.09	+0.40	+0.41	−0.08	+0.07	+0.43	−0.84	−2.3	−0.7
22	Berlin	B. D. +27° 734	I	−0.76	+0.02	−0.14	−0.62	−0.64	−0.14	+0.07	−0.59	−0.70	−2.0	−0.7
23	Berlin	B. D. +27° 888	I	−0.97	−0.19	−0.12	−0.30	−0.32	−0.13	0.00	−0.29	−0.78	−3.7	−2.0
23	Berlin	B. D. +28° 918	I	−0.68	−0.13	−0.28	−0.70	−0.75	−0.08	−0.02	−0.72	−0.55	−2.4	−1.2
23	Berlin	B. D. +28° 939	I	−0.80	−0.16	−0.25	−0.58	−0.63	−0.10	−0.01	−0.60	−0.64	−1.1	+0.3
23	Berlin	B D. +27° 909	I	−1.02	−0.20	−0.02	−0.05	−0.05	−0.13	−0.01	−0.02	−0.82	−4.1	−2.3
23	Berlin	B. D. +27° 912	I	−0.97	−0.20	−0.13	−0.30	−0.32	−0.13	−0.01	−0.29	−0.78	−2.7	−1.0
23	Berlin	B. D. +27° 913	I	−0.88	−0.17	−0.20	−0.46	−0.50	−0.11	−0.01	−0.48	−0.71	−2.2	−0.6
23	Berlin	B. D. +27° 915	I	−0.97	−0.20	−0.12	−0.29	−0.31	−0.12	−0.02	−0.27	−0.78	−3.2	−1.5
23	Berlin	B. D. +27° 914	I	−0.74	−0.15	+0.27	+0.63	+0.68	−0.10	−0.01	+0.71	−0.60	−1.8	−0.5
23	Berlin	B. D. +28° 955	I	−0.80	−0.16	−0.25	−0.57	−0.62	−0.09	−0.02	−0.59	−0.64	−2.3	−0.9
23	Berlin	B. D. +27° 932	I	−0.96	−0.19	+0.14	+0.31	+0.34	−0.13	−0.02	+0.38	−0.77	−1.8	−0.1
23	Berlin	B. D. +27° 933	I	−1.02	−0.20	−0.01	−0.02	−0.02	−0.14	−0.02	+0.02	−0.82	−3.7	−1.9
23	Berlin	B. D. +27° 940	I	−0.45	−0.09	+0.36	+0.83	+0.90	−0.08	0.00	+0.92	−0.36	+0.4	+1.2
23	Berlin	B. D. +27° 938	I	−0.35	−0.07	−0.38	+0.86	+0.94	−0.07	0.00	+0.95	−0.28	+1.4	+2.0
23	Berlin	415 B. Tauri	I	−0.72	−0.14	+0.28	+0.65	+0.71	−0.10	0.00	+0.73	−0.58	−1.9	−0.6
23	Berlin	B. D. +27° 950	I	−1.01	−0.20	+0.06	+0.14	+0.15	−0.14	−0.03	+0.19	−0.81	−2.8	−1.0
24	Berlin	B. D. +26° 1453	I	−0.59	−0.27	+0.55	+0.64	+0.83	−0.21	−0.08	+0.82	−0.36	−1.2	−0.2
24	Berlin	B. D. +25° 1594	I	−1.01	−0.46	+0.18	+0.21	+0.28	−0.21	−0.15	+0.32	−6.61	−1.7	+0.1
24	Berlin	B. D. +25° 1595	I	−1.02	−0.47	+0.16	+0.18	+0.24	−0.20	−0.15	+0.27	−0.62	−0.9	+0.9
24	Berlin	B. D. +25° 1596	I	−0.89	−0.41	+0.35	+0.40	+0.53	−0.22	−0.14	+0.55	−0.54	−2.8	−1.2
24	Berlin	B. D. +26° 1485	I	−0.68	−0.31	−0.51	−0.59	−0.77	+0.01	−0.13	−0.71	−0.42	−3.4	−2.2
24	Berlin	B. D. +25° 1608	I	−1.03	−0.47	+0.12	+0.14	+0.18	−0.20	−0.16	+0.22	−0.63	−2.0	−0.2
24	Berlin	49 Geminor.	I	−0.84	−0.38	−0.38	−0.45	−0.59	−0.04	−0.16	−0.54	−0.51	−1.3	+0.2
26	Berlin	78 Cancri	I	−1.04	−0.74	+0.30	+0.12	+0.32	−0.32	−0.33	+0.28	−0.31	−0.7	+1.1
Mar. 1	Greenwich	343 B. Virginis	E	+0.96	+0.81	+0.40	−0.36	+0.54	−0.03	+0.45	−0.20	−0.16	+1.6	+0.3
8	Cape	*h* Sagittarii	E	+0.81	−0.21	+0.40	+0.37	−0.55	−0.03	−0.18	+0.49	−0.75	+2.3	+1.2
19	Greenwich	18 Tauri	I	−0.90	+0.40	+0.20	+0.13	−0.24	−0.09	+0.22	−0.17	−0.91	−4.3	−2.7
21	Berlin	B. D. +27° 799	I	−0.99	−0.09	−0.07	−0.20	−0.22	−0.13	+0.02	−0.17	−0.97	−3.1	−1.3
21	Berlin	B. D. +27° 798	I	−0.54	−0.05	−0.28	−0.80	−0.85	−0.09	+0.03	−0.82	−0.52	−1.0	0.0
21	Berlin	B. D. +27° 803	I	−1.01	−0.09	+0.01	+0.04	+0.04	−0.13	+0.03	+0.08	−0.99	−3.9	−2.1
21	Berlin	107 B. Aurigæ	I	−0.82	−0.07	+0.20	+0.56	+0.59	−0.09	+0.02	+0.61	−0.80	−3.8	−2.3
21	Berlin	B. D. +27° 811	I	−0.91	−0.08	−0.15	−0.40	−0.43	−0.12	+0.02	−0.39	−0.89	−1.9	−0.3
21	Berlin	B. D. +27° 824	I	−0.82	−0.07	−0.21	−0.54	−0.58	−0.12	+0.03	−0.56	−0.80	−2.1	−0.6
21	Berlin	B. D. +27° 830	I	−0.54	−0.05	+0.31	+0.79	+0.85	−0.05	0.00	+0.87	−0.52	−2.3	−1.3
21	Berlin	B. D. +27° 833	I	−0.94	−0.08	−0.13	−0.33	−0.36	−0.12	+0.02	−0.32	−0.92	−2.3	−0.6
21	Berlin	B. D. +27° 832	I	−0.42	−0.04	+0.34	+0.85	+0.91	−0.04	−0.01	+0.92	−0.42	+2.3	+3.0
21	Berlin	B. D. +27° 837	I	−1.00	−0.09	+0.05	+0.12	+0.13	−0.13	+0.01	+0.18	−0.98	−2.8	−1.0
21	Berlin	B. D. +27° 849	I	−0.81	−0.07	−0.22	−0.56	−0.60	−0.11	+0.01	−0.56	−0.79	−1.3	+0.2
22	Berlin	B. D. +27° 1144	I	−1.01	−0.30	−0.90	−0.14	−0.17	−0.12	−0.08	−0.14	−0.93	−2.8	−1.0
22	Berlin	B. D. +27° 1148	I	−0.84	−0.25	+0.31	+0.48	+0.57	−0.15	−0.07	+0.59	−0.78	−3.5	−2.0
22	Berlin	B. D. +27° 1164	I	−0.62	−0.19	−0.43	−0.67	−0.80	−0.01	+0.07	−0.77	−0.57	−1.8	−0.7
22	Berlin	B. D. +27° 1167	I	−0.94	−0.28	+0.24	+0.35	+0.42	−0.17	−0.09	+0.45	−0.86	−2.0	−0.3
22	Berlin	B. D. +27° 1181	I	−1.01	−0.30	+0.11	+0.16	+0.19	−0.16	−0.10	+0.23	−0.93	−1.4	+0.4
22	Berlin	B. D. +26° 1317	I	−0.92	−0.28	+0.26	+0.38	+0.46	−0.18	−0.10	+0.49	−0.85	−2.3	−0.7
22	Berlin	B. D. +26° 1333	I	−0.33	−0.10	+0.54	+0.78	+0.95	−0.14	−0.02	+0.95	−0.30	+2.3	+2.9
22	Berlin	B. D. +26° 1350	I	−0.82	−0.25	+0.34	+0.46	+0.58	−0.17	−0.10	+0.63	−0.76	−2.3	−0.8
23	Berlin	B. D. +25° 1706	I	−1.06	−0.52	+0.07	+0.06	+0.09	−0.18	−0.14	+0.12	−0.87	−2.2	−0.3
23	Berlin	B. D. +25° 1709	I	−0.95	−0.47	−0.32	−0.30	−0.44	−0.09	−0.14	−0.37	−0.78	−2.4	−0.7
23	Berlin	B. D. +25° 1725	I	−0.88	−0.43	−0.42	−0.37	−0.56	−0.06	−0.14	−0.48	−0.72	−1.7	−0.1
23	Berlin	176 B. Geminor.	I	−0.82	−0.40	+0.46	+0.41	+0.62	−0.22	−0.11	+0.62	−0.67	−2.5	−1.0
23	Berlin	B. D. +24° 1729	I	−0.89	−0.44	+0.41	+0.36	+0.54	−0.21	−0.11	+0.54	−0.73	−1.3	+0.3
23	Berlin	181 B. Geminor.	I	−0.67	−0.33	+0.58	+0.52	+0.78	−0.22	−0.09	+0.75	−0.55	−1.4	−0.2
23	Berlin	B. D. +24° 1740	I	−0.90	−0.44	+0.40	+0.34	+0.53	−0.22	−0.11	+0.53	−0.74	−1.4	+0.2
23	Berlin	B. D. +24° 1746	I	−1.06	−0.52	+0.01	+0.01	+0.01	−0.17	−0.16	+0.06	−0.87	−3.3	−1.4
23	Berlin	B. D. +24° 1750	I	−0.66	−0.32	+0.60	+0.51	+0.79	−0.27	−0.12	+0.76	−0.54	−1.4	−0.2
23	Berlin	B. D. +24° 1755	I	−0.51	−0.25	−0.67	−0.57	−0.88	−0.09	−0.15	−0.79	−0.42	−2.1	−1.2
25	Berlin	B. D. +15° 2075	I	−1.08	−p.84	+0.16	+0.04	+0.17	−0.27	−0.38	+0.17	−0.57	−0.5	+1.4
25	Berlin	B. D. +15° 2079	I	−0.92	−0.71	+0.52	+0.11	+0.53	−0.38	−0.30	+0.38	−0.49	−2.7	−1.1
25	Berlin	B. D. +15° 2080	I	−0.93	−0.72	+0.51	+0.11	+0.52	−0.38	−0.30	+0.38	−0.49	−3.0	−1.3

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1896, Mar. 25	Berlin	11 Leonis	I	−0.96	−0.75	+0.46	+0.10	+0.47	−0.36	−0.31	+0.35	−0.51	−2.3	−0.6
25	Berlin	B.D. +15° 2091	I	−1.06	−0.82	−0.22	−0.05	−0.22	−0.12	−0.40	−0.08	−0.56	−3.3	−1.4
27	Greenwich	79 Leonis	I	−0.86	−0.73	+0.64	−0.19	+0.67	−0.51	−0.27	+0.15	−0.20	+0.3	+1.8
27	Greenwich	79 Leonis	EB	+1.06	+0.90	+0.37	−0.12	+0.39	+0.06	+0.47	+0.02	+0.25	−1.3	−2.8
Apr. 1	Santiago	α Scorpii	IB	−0.93	−0.46	+0.05	+0.48	−0.49	−0.08	−0.15	+0.48	+0.64	+0.3	+2.0
1	Santiago	α Scorpii	E	+0.68	+0.33	+0.08	+0.76	−0.77	+0.41	+0.09	+0.70	−0.46	+1.3	+0.3
1	Santiago	116 B. Scorpii	IB	−0.77	−0.38	+0.08	+0.68	−0.69	−0.03	−0.12	+0.63	+0.53	−4.3	−2.9
1	Santiago	116 B. Scorpii	E	+0.43	+0.21	+0.11	+0.91	−0.91	+0.20	+0.06	+0.83	−0.30	+0.2	−0.4
7	Cape	μ Capricor.	E	+0.92	−0.73	0.00	0.00	0.00	+0.05	−0.42	−0.05	−0.85	+1.4	+0.1
15	Berlin	B.D. +23° 462	I	−0.85	+0.41	−0.05	+0.45	+0.45	+0.04	+0.25	+0.41	−0.58	−4.0	−2.5
15	Berlin	B.D. +23° 463	I	−0.84	+0.40	−0.06	+0.48	+0.48	+0.04	+0.23	+0.43	−0.57	−3.4	−1.9
15	Berlin	B.D. +23° 469	I	−0.95	+0.46	0.00	−0.02	−0.02	−0.08	+0.26	+0.03	−0.65	−3.4	−1.7
17	Santiago	β Tauri	I	−0.17	+0.02	+0.34	+0.92	+0.98	+0.03	+0.01	+0.98	−0.17	+1.7	+2.0
17	Santiago	β Tauri	EB	+0.24	−0.02	+0.34	+0.91	+0.97	+0.06	−0.01	+0.96	+0.22	+1.0	+0.5
19	Hamburg	A Geminor.	I	−0.83	−0.30	−0.42	−0.29	−0.57	0.00	−0.18	−0.49	−0.82	−1.6	−0.1
20	Berlin	B.D. +22° 1901	I	−1.07	−0.63	−0.02	−0.01	−0.02	−0.18	−0.29	+0.03	−0.97	−4.0	−2.1
20	Berlin	B.D. +21° 1807	I	−1.04	−0.61	+0.21	+0.13	+0.26	−0.25	−0.26	+0.27	−0.94	−1.3	+0.6
22	Kasan	ν Leonis	I	−0.91	−0.71	−0.54	−0.05	−0.54	+0.05	−0.39	−0.26	−0.77	−0.6	+1.0
22	Cape	α Leonis	I	−1.03	−0.83	+0.35	0.00	+0.35	−0.36	−0.37	+0.22	−0.78	−0.9	+1.0
25	Cape	ψ Virginis	I	−1.09	−0.96	+0.15	−0.15	+0.21	−0.33	−0.42	0.00	−0.32	+0.9	+2.9
26	Greenwich	83 Virginis	I	−1.15	−0.93	+0.01	−0.02	+0.02	−0.28	−0.41	+0.03	+0.16	−2.3	−0.2
26	Berlin	83 Virginis	I	−1.05	−0.88	−0.18	+0.27	−0.32	−0.09	−0.31	+0.20	−0.15	−1.6	+0.3
May 1	Cape	σ Sagittarii	IB	−0.70	+0.13	+0.45	+0.54	−0.70	−0.18	+0.09	+0.73	+0.57	+0.5	+1.8
1	Cape	σ Sagittarii	E	+0.49	−0.09	+0.56	+0.67	−0.87	−0.04	−0.08	+0.71	−0.40	+2.0	+1.3
1	Santiago	201 B. Sagittarii	EB	+0.99	+0.06	+0.09	+0.09	−0.13	+0.09	−0.18	+0.07	−0.78	0.0	−1.4
16	Berlin	B.D. +25° 1570	I	−0.99	−0.30	−0.20	−0.20	−0.28	−0.10	−0.17	−0.21	−0.83	−2.5	−0.7
16	Berlin	B.D. +25° 1579	I	−0.90	−0.27	−0.36	−0.36	−0.50	−0.06	−0.16	−0.44	−0.75	−1.7	−0.1
16	Berlin	B.D. +25° 1590	I	−1.02	−0.31	−0.12	−0.11	−0.16	−0.12	−0.18	−0.11	−0.85	−2.4	−0.5
16	Berlin	B.D +25° 1584	I	−0.23	−0.07	+0.70	+0.68	+0.97	−0.19	−0.03	+0.97	−0.19	+1.8	+2.2
17	Berlin	B.D. +22° 1836	I	−1.03	−0.48	+0.19	+0.13	+0.23	−0.22	−0.25	+0.25	−0.91	+0.8	+2.7
17	Berlin	B.D. +22° 1834	I	−0.82	−0.38	+0.54	+0.35	+0.64	−0.29	−0.18	+0.63	−0.72	−0.6	+0.9
17	Berlin	B.D +22° 1852	I	−1.06	−0.50	−0.04	−0.03	−0.05	−0.16	−0.27	+0.01	−0.94	−2.3	−0.4
20	Cape	ρ Leonis	I	−0.93	−0.75	+0.53	−0.05	+0.53	−0.43	−0.32	+0.25	−0.84	−1.9	−0.2
21	Berlin	B.D. + 0° 2801	I	−0.31	−0.27	+0.88	−0.38	+0.96	−0.53	−0.02	+0.16	−0.24	+0.8	+1.4
21	Berlin	υ Leonis	I	−1.11	−0.98	−0.04	+0.02	−0.04	−0.21	−0.45	+0.06	−0.90	−3.1	−1.1
21	Greenwich	υ Leonis	I	−1.09	−0.97	+0.12	−0.05	+0.13	−0.27	−0.45	+0.07	−0.89	+0.3	+2.3
23	Berlin	B.D. −12° 3785	I	−0.99	−0.94	−0.26	+0.33	−0.42	0.00	−0.40	+0.20	−0.55	−3.0	−1.1
25	Berlin	C.D. −23° 12133	I	−1.03	−0.67	+0.04	−0.30	+0.30	−0.27	−0.27	−0.17	−0.22	−2.7	−0.8
25	Berlin	C.D. −23° 12202	I	−0.72	−0.48	−0.09	+0.75	−0.75	+0.06	−0.21	+0.63	−0.15	−1.3	0.0
25	Berlin	C.D. −23° 12208	I	−0.51	−0.33	−0.11	+0.89	−0.89	+0.12	−0.17	+0.72	−0.11	−1.1	−0.2
26	Santiago	α Scorpii	I	−1.02	−0.56	−0.05	−0.36	+0.36	−0.24	−0.14	−0.29	−0.06	−1.2	+0.7
26	Cape	α Scorpii	IB	−0.76	−0.39	+0.12	+0.68	−0.70	−0.05	−0.11	+0.69	0.00	−0.6	+0.8
26	Cape	α Scorpii	E	+0.94	+0.48	+0.08	+0.45	−0.46	+0.22	+0.13	+0.39	0.00	+1.0	−0.4
31	Berlin	30 Capricor.	E	+0.86	−0.53	−0.39	−0.09	+0.39	+0.19	−0.34	−0.31	−0.81	+2.0	+0.7
June 2	Berlin	B.D. − 8° 5961	E	+0.53	−0.52	−0.81	+0.02	+0.81	+0.38	−0.18	−0.31	−0.59	−0.2	−0.9
2	Berlin	B.D. − 7° 5873	E	+0.20	−0.19	+0.97	−0.02	−0.97	−0.43	−0.20	+0.35	−0.22	+1.3	+1.0
2	Berlin	B.D. − 8° 5964	E	+0.74	−0.72	−0.57	+0.01	+0.57	+0.27	−0.31	−0.24	−0.82	+0.9	−0.2
3	Berlin	14 Piscium	E	+0.65	−0.63	+0.63	−0.27	−0.69	−0.31	−0.40	+0.06	−0.72	+2.2	+1.2
14	Berlin	B.D. +19° 2094	I	−1.06	−0.60	−0.14	−0.05	−0.15	−0.13	−0.33	−0.07	−0.80	−2.7	−0.7
14	Berlin	B.D. +19° 2095	I	−1.07	−0.61	0.00	0.00	0.00	−0.18	−0.32	+0.05	−0.79	−0.9	+1.1
14	Berlin	B.D. +19° 2097	I	−0.28	−0.16	−0.89	−0.35	−0.97	+0.26	−0.15	−0.75	−0.21	−2.4	−1.9
15	Berlin	B.D. +14° 2123	I	−1.08	−0.77	+0.12	+0.02	+0.12	−0.25	−0.37	+0.15	−0.89	−0.4	+1.6
19	Cape	ψ Virginis	I	−0.92	−0.83	+0.37	−0.40	+0.55	−0.46	−0.32	−0.10	−0.80	−2.0	−0.3
22	Cape	A Scorpii	I	−1.07	−0.68	0.00	−0.03	+0.03	−0.21	−0.22	+0.01	−0.58	−1.6	+0.4
22	Berlin	C.D. −26° 11106	I	−0.77	−0.49	−0.04	−0.70	+0.70	−0.27	−0.14	−0.56	−0.42	−4.6	−3.1
22	Greenwich	4 Scorpii	I	−0.63	−0.40	+0.04	+0.81	−0.81	+0.04	−0.14	+0.74	−0.34	−1.1	+0.1
24	Greenwich	38 B. Sagittarii	I	−0.89	−0.24	+0.28	+0.44	−0.52	−0.15	+0.04	+0.56	−0.14	−1.2	+0.5
July 6	Berlin	B.D +24° 584	E	+0.91	−0.54	+0.01	+0.22	+0.22	+0.10	−0.22	+0.16	−0.60	+2.1	+0.7
6	Berlin	B.D. +24° 589	E	+0.93	−0.55	−0.01	−0.15	−0.15	+0.03	−0.22	−0.18	−0.61	+3.2	+1.8
6	Berlin	B.D. +24° 593	E	+0.64	−0.38	+0.04	+0.73	+0.73	+0.17	−0.12	+0.62	−0.42	+0.6	−0.4
20	Greenwich	τ Scorpii	EB	+0.91	+0.55	−0.12	−0.48	+0.49	+0.08	+0.12	−0.50	+0.70	−2.6	−4.0
20	Pola	τ Scorpii	I	−0.86	−0.52	−0.13	−0.55	+0.56	−0.20	−0.11	−0.48	−0.67	−1.0	+0.6
27	Berlin	B.D. − 6° 6110	E	+0.82	−0.77	+0.42	−0.12	−0.44	−0.18	−0.46	+0.09	−0.54	+3.1	+1.9
27	Berlin	B.D. − 6° 6112	E	+0.88	−0.83	+0.22	−0.06	−0.23	−0.08	−0.48	+0.03	+0.58	+3.3	+2.0
27	Berlin	B.D. − 6° 6125	E	+0.33	−0.32	−0.89	+0.26	+0.93	+0.42	−0.07	−0.29	−0.22	−1.8	−2.3
28	Greenwich	21 Piscium	E	+0.58	−0.58	−0.65	+0.40	+0.77	+0.41	−0.19	−0.08	−0.46	+0.9	0.0
31	Cape	ι Arietis	E	+0.84	−0.88	+0.14	−0.34	−0.36	−0.11	−0.38	−0.25	−0.93	+4.5	+3.2
Aug. 5	Berlin	B.D. +26° 1205	E	+1.09	+0.88	−0.10	−0.13	−0.17	+0.23	+0.08	−0.20	−0.67	+4.8	+3.2
5	Berlin	B.D. +26° 1227	E	+1.07	+0.86	−0.16	−0.20	−0.25	+0.23	+0.08	−0.24	−0.66	+4.6	+3.0
5	Berlin	B.D. +26° 1230	E	+1.05	+0.85	+0.19	+0.24	+0.31	+0.19	+0.09	+0.30	−0.65	+3.9	+2.3

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1896, Aug. 5	Berlin	B.D. +27° 1122	E	+0.53	+0.43	−0.55	−0.69	−0.88	+0.19	+0.04	+0.91	−0.33	+1.5	+0.7
20	Cape	4 Capricor.	I	−0.97	+0.14	−0.14	−0.06	+0.15	−0.10	+0.29	−0.08	−0.57	−0.4	+1.5
21	Berlin	B.D. −18° 5875	IB	−0.95	+0.44	−0.09	−0.02	+0.09	−0.04	+0.39	−0.03	−0.31	−1.1	+0.8
23	Berlin	B.D. − 8° 5932	E	+0.68	−0.59	−0.63	+0.16	+0.65	+0.32	−0.28	−0.27	−0.09	−3.1	−4.1
27	Berlin	B.D. +14° 249	E	+0.79	−0.85	+0.22	−0.40	−0.46	−0.18	−0.40	−0.25	−0.75	+2.8	+1.6
28	Berlin	B.D. +17° 346	E	+0.89	−0.88	+0.03	−0.12	−0.12	−0.03	−0.38	−0.12	−0.91	+2.8	+1.5
28	Berlin	B.D. +18° 300	E	+0.83	−0.82	+0.12	−0.38	−0.40	−0.11	−0.35	−0.29	−0.85	+2.5	+1.2
28	Berlin	B.D. +18° 305	E	+0.31	−0.30	−0.26	+0.90	+0.94	+0.32	−0.06	+0.56	−0.31	+0.5	0.0
28	Berlin	B.D. +18° 312	E	+0.71	−0.70	−0.16	+0.57	+0.61	+0.21	−0.24	+0.16	−0.73	+1.8	+0.7
28	Berlin	B.D. +19° 362	E	+0.38	−0.37	+0.24	−0.88	−0.91	−0.28	−0.21	−0.60	−0.39	+2.1	+1.5
28	Berlin	26 Arietis	E	+0.84	−0.83	+0.10	−0.37	−0.38	−0.10	−0.42	−0.29	−0.86	+3.6	+2.3
29	Berlin	B.D. +21° 418	E	+0.89	−0.74	−0.02	+0.24	+0.24	+0.09	−0.27	+0.12	−0.95	+2.2	+0.8
29	Berlin	B.D. +21° 423	E	+0.76	−0.63	−0.04	+0.55	+0.55	+0.16	−0.22	+0.38	−0.81	+0.8	−0.4
29	Berlin	B.D. +22° 455	E	+0.84	−0.69	+0.03	−0.40	−0.40	−0.08	−0.25	−0.36	−0.89	+1.3	0.0
29	Berlin	161 B. Arietis	E	+0.72	−0.59	+0.04	−0.62	−0.62	−0.13	−0.24	−0.51	−0.76	+0.7	−0.4
29	Berlin	B.D. +22° 465	E	+0.91	−0.75	+0.01	−0.17	−0.17	−0.01	−0.25	−0.19	−0.97	+2.3	+0.9
30	Berlin	B.D. +25° 678	E	+0.67	−0.53	−0.12	−0.68	−0.69	−0.08	−0.14	−0.66	−0.72	+0.5	−0.5
Sept. 3	Berlin	B.D. +22° 1810	E	+0.66	+0.19	+0.68	+0.37	+0.77	−0.09	+0.21	+0.65	−0.40	+2.0	+1.0
3	Berlin	B.D. +22° 1834	E	+0.62	+0.17	+0.71	+0.38	+0.80	−0.10	+0.20	+0.69	−0.37	+1.9	+0.9
5	Cape	α Leonis	IB	−0.59	−0.38	−0.84	+0.07	−0.84	+0.23	−0.32	−0.42	+0.12	−1.7	−0.7
14	Berlin	C.D. −28° 14143	I	−0.98	−0.36	+0.20	+0.27	−0.34	−0.16	+0.05	+0.39	−0.94	+0.1	+2.0
14	Berlin	C.D. −28° 14144	I	−0.42	−0.15	+0.55	+0.74	−0.92	−0.11	+0.01	+0.94	−0.40	+0.6	+1.4
14	Berlin	38 B. Sagittarii	I	−0.94	−0.34	+0.25	+0.34	−0.42	−0.16	+0.06	+0.48	−0.90	+0.3	+2.2
18	Cape	42 Capricor.	I	−0.93	+0.41	−0.21	−0.01	+0.21	+0.01	+0.41	−0.09	−0.67	−1.8	+0.1
23	Berlin	B.D. +11° 172	E	+0.89	−1.00	+0.04	−0.06	−0.07	−0.02	−0.43	−0.08	−0.40	+4.6	+3.2
26	Berlin	17 Tauri	E	+0.48	−0.36	+0.08	+0.86	+0.86	+0.20	−0.09	+0.71	−0.45	+0.2	−0.6
26	Berlin	B.D. +23° 504	E	+0.87	−0.66	−0.03	−0.30	−0.30	−0.03	−0.21	−0.30	−0.83	+3.3	+1.9
26	Berlin	16 Tauri	E	+0.92	−0.70	−0.01	−0.07	−0.07	+0.10	−0.22	−0.11	−0.87	+2.4	+0.9
26	Berlin	q Tauri	E	+0.86	−0.66	−0.04	−0.34	−0.34	−0.03	−0.21	−0.34	−0.82	+2.5	+1.1
26	Berlin	B.D. +23° 519	E	+0.32	−0.24	+0.10	+0.93	+0.93	+0.20	−0.06	+0.81	−0.30	−0.8	−1.3
26	Berlin	B.D. +23° 512	E	+0.87	−0.66	+0.03	+0.30	+0.30	+0.08	−0.19	+0.22	−0.83	+1.3	−0.1
26	Berlin	B.D. +24° 550	E	+0.90	−0.69	−0.02	−0.20	−0.20	0.00	−0.21	−0.24	−0.85	+3.1	+1.7
26	Berlin	20 Tauri	E	+0.90	−0.68	+0.03	+0.24	+0.24	+0.08	−0.20	+0.16	−0.84	+2.5	+1.1
26	Berlin	B.D. +23° 523	E	+0.53	−0.41	+0.09	+0.82	+0.82	+0.17	−0.09	+0.67	−0.50	+1.0	+0.2
26	Berlin	21 Tauri	E	+0.82	−0.62	−0.05	−0.46	−0.46	−0.05	−0.19	−0.44	−0.77	+3.2	+1.9
26	Berlin	22 Tauri	E	+0.87	−0.66	−0.03	−0.31	−0.31	−0.03	−0.21	−0.32	−0.83	+2.9	+1.5
26	Berlin	B.D. +23° 540	E	+0.24	−0.18	+0.11	+0.97	+0.97	+0.20	−0.03	+0.81	−0.23	−1.5	−1.9
26	Berlin	B.D. +24° 562	E	+0.92	−0.70	0.00	+0.04	+0.04	+0.05	−0.22	−0.03	−0.87	+4.1	+2.6
26	Berlin	B.D. +24° 566	E	+0.92	−0.70	−0.01	−0.10	−0.10	+0.03	−0.23	−0.14	−0.87	+2.5	+1.0
26	Berlin	B.D. +24° 567	E	+0.86	−0.65	−0.04	−0.36	−0.36	−0.03	−0.21	−0.36	−0.81	+1.7	+0.3
26	Berlin	B.D. +24° 577	E	+0.78	−0.60	+0.07	+0.51	+0.52	+0.12	−0.16	+0.40	−0.74	+1.9	+0.7
26	Berlin	B.D. +24° 587	E	+0.56	−0.43	−0.11	−0.79	−0.80	−0.12	−0.15	−0.92	−0.53	+2.7	+1.8
26	Berlin	B.D. +24° 598	E	+0.92	−0.70	+0.01	+0.04	+0.04	+0.05	−0.21	−0.01	−0.87	+3.7	+2.2
28	Berlin	B.D. +27° 818	E	+0.96	−0.29	−0.06	−0.10	−0.12	+0.09	0.00	−0.18	−0.99	+1.9	+0.4
28	Berlin	B.D. +27° 832	E	+0.84	−0.25	−0.27	−0.42	−0.50	+0.07	0.00	−0.54	−0.87	+1.6	+0.2
28	Berlin	B.D. +27° 846	E	+0.90	−0.27	+0.19	+0.30	+0.36	+0.08	0.00	+0.30	−0.93	+1.3	−0.1
28	Berlin	B.D. +27° 850	E	+0.75	−0.22	+0.35	+0.54	+0.64	+0.06	−0.03	−0.61	−0.77	+3.0	+1.8
28	Berlin	B.D. +27° 856	E	+0.80	−0.24	+0.31	+0.47	+0.57	+0.07	+0.01	+0.53	−0.82	+2.1	+0.8
28	Berlin	B.D. +27° 866	E	+0.38	−0.11	−0.50	−0.77	−0.92	+0.04	0.00	−0.94	−0.39	−0.1	−0.7
29	Berlin	B.D. +26° 1276	E	+0.97	−0.07	−0.13	−0.14	−0.19	+0.12	+0.12	−0.25	−0.96	+1.8	+0.3
29	Berlin	B.D. +26° 1292	E	+0.78	−0.06	+0.42	+0.43	+0.60	+0.02	+0.07	+0.56	−0.77	+2.7	+1.5
29	Berlin	B.D. +26° 1298	E	+0.99	−0.07	+0.04	+0.04	+0.05	0.00	+0.13	−0.02	−0.99	+2.2	+0.6
29	Berlin	B.D. +26° 1304	E	+0.68	−0.05	−0.51	−0.51	−0.72	+0.15	+0.09	−0.76	−0.68	+1.6	+0.5
29	Berlin	B.D. +26° 1300	E	+0.95	−0.07	−0.18	−0.18	−0.26	+0.12	+0.12	−0.31	−0.94	+1.4	−0.1
29	Berlin	B.D. +26° 1302	E	+0.86	−0.06	+0.34	+0.34	+0.48	+0.03	+0.10	+0.44	−0.85	+1.9	+0.5
29	Berlin	B.D. +26° 1308	E	+0.98	−0.07	+0.08	+0.08	+0.11	+0.09	+0.13	+0.05	−0.97	+3.1	+1.5
29	Berlin	B.D. +26° 1309	E	+0.75	−0.05	+0.45	+0.45	+0.64	+0.01	+0.08	+0.60	−0.74	+2.4	+1.2
29	Berlin	B.D. +26° 1311	E	+0.57	−0.04	+0.58	+0.58	+0.81	−0.03	+0.06	+0.78	−0.57	+0.9	0.0
29	Berlin	B.D. +26° 1326	E	+0.47	−0.03	−0.63	−0.62	−0.88	+0.15	+0.07	−0.90	−0.46	0.0	−0.8
29	Berlin	B.D. +26° 1321	E	+0.97	−0.07	−0.12	−0.12	−0.17	+0.12	+0.13	−0.24	−0.95	+2.3	+0.8
29	Berlin	B.D. +26° 1322	E	+0.93	−0.07	+0.24	+0.24	+0.34	+0.06	+0.12	+0.29	−0.92	+1.6	+0.1
29	Berlin	B.D. +26° 1327	E	+0.65	−0.05	+0.54	+0.53	+0.76	−0.02	+0.09	+0.70	−0.65	+1.8	+0.8
29	Berlin	B.D. +26° 1331	E	+0.94	−0.07	−0.22	−0.22	−0.31	+0.13	+0.13	−0.36	−0.93	+0.9	−0.6
29	Berlin	B.D. +26° 1332	E	+0.98	−0.07	−0.12	−0.12	−0.17	+0.12	+0.12	−0.21	−0.97	+2.1	+0.5
29	Berlin	B.D. +26° 1333	E	+0.97	−0.07	−0.13	−0.13	−0.18	+0.12	+0.13	−0.24	−0.96	+1.0	−0.5
29	Berlin	B.D. +26° 1338	E	+0.86	−0.06	+0.35	+0.34	+0.49	+0.03	+0.11	+0.43	−0.85	+2.0	+0.6
29	Berlin	B.D. +26° 1342	E	+0.67	−0.05	+0.53	+0.50	+0.73	−0.02	−0.09	+0.65	−0.67	+1.8	+0.7
Oct. 9	Cape	α Scorpii	I	−0.99	−0.71	+0.10	+0.38	−0.39	−0.14	−0.13	+0.41	−0.61	−0.8	+1.2
10	Cape	α Scorpii	EB	+0.80	+0.57	+0.19	+0.64	−0.67	+0.21	+0.07	+0.55	+0.49	+0.8	−0.5
16	Kasan	ε Aquarii	I	−0.93	+0.48	−0.03	0.00	+0.03	−0.06	+0.41	+0.09	−0.89	+0.5	+2.4

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1896, Oct. 18	Berlin	B. D. − 0° 4558	I	−0.89	+0.88	−0.06	+0.04	+0.07	+0.02	+0.47	+0.04	−0.54	−2.8	−1.0
24	Berlin	B. D. +25° 703	E	+0.74	−0.51	−0.15	−0.56	−0.58	−0.06	−0.10	−0.59	−0.53	+0.5	−0.7
24	Berlin	χ Tauri	E	+0.70	−0.48	+0.17	+0.65	+0.67	+0.12	−0.11	+0.57	−0.50	+2.4	+1.2
25	Berlin	B. D. +26° 827	E	+0.83	−0.50	+0.24	+0.40	+0.47	+0.05	−0.01	+0.41	−0.62	+1.0	−0.4
27	Berlin	B. D. +25° 1597	E	+0.84	−0.06	−0.42	−0.30	−0.52	+0.17	−0.16	−0.55	−0.82	+0.4	−1.0
27	Berlin	B. D. +24° 1549	E	+0.45	−0.03	+0.72	+0.52	+0.89	−0.10	−0.10	+0.83	−0.43	+1.3	+0.6
27	Berlin	B. D. +24° 1562	E	+0.74	−0.05	+0.52	+0.38	+0.65	−0.03	+0.13	+0.59	−0.72	+1.8	+0.6
27	Berlin	B. D. +24° 1567	E	+0.59	−0.04	+0.65	+0.46	+0.80	−0.08	+0.11	+0.75	−0.58	+1.6	+0.6
27	Berlin	B. D. +24° 1576	E	+0.84	−0.06	+0.42	+0.30	+0.52	0.00	+0.16	+0.46	−0.82	+2.3	+0.9
27	Berlin	52 Geminor.	E	+0.97	−0.07	−0.14	−0.10	−0.17	+0.13	+0.19	−0.23	−0.94	+1.4	−0.2
27	Berlin	B. D. +25° 1625	E	+0.92	−0.07	−0.28	−0.21	−0.36	+0.17	+0.19	−0.40	−0.89	+1.0	−0.5
27	Berlin	B. D. +24° 1627	E	+0.99	−0.07	−0.05	−0.03	−0.06	+0.12	+0.20	−0.11	−0.96	+1.2	−0.4
27	Greenwich	52 Geminor.	IB	−0.80	+0.06	−0.45	−0.33	−0.56	+0.03	−0.16	−0.50	−0.80	−3.2	−1.6
30	Berlin	B. D. +11° 2153	E	+1.01	+0.49	+0.30	−0.03	+0.30	+0.04	+0.44	+0.10	−0.90	+0.7	−0.9
30	Berlin	B. D. +11° 2162	E	+1.06	+0.52	0.00	0.00	0.00	+0.17	+0.41	−0.07	−0.95	+1.0	−0.7
Nov. 9	Cape	χ Sagittarii	I	−0.55	−0.15	−0.72	−0.45	+0.85	+0.07	+0.13	−0.77	−0.41	−3.4	−2.3
9	Cape	χ Sagittarii	EB	+0.19	+0.05	−0.83	−0.52	+0.98	+0.20	−0.01	−0.93	+0.15	−1.7	−2.0
9	Cape	49 Sagittarii	I	−0.32	−0.08	+0.81	+0.50	−0.95	−0.22	+0.03	+0.91	−0.24	−0.5	+0.1
10	Berlin	B. D. −22° 5389	I	−0.95	+0.03	+0.31	+0.10	−0.32	−0.21	+0.27	+0.33	−0.87	−1.9	0.0
12	Berlin	B. D. −12° 6153	I	−0.72	+0.36	+0.64	−0.07	−0.64	−0.32	+0.27	+0.40	−0.76	−0.8	+0.7
12	Berlin	B. D. −12° 6152	I	−0.71	+0.36	+0.67	−0.07	−0.67	−0.33	+0.25	+0.41	−0.75	−1.1	+0.4
13	Berlin	B. D. − 7° 5837	I	−0.85	+0.59	+0.39	−0.12	−0.41	−0.23	+0.37	+0.21	−0.88	−1.0	+0.7
13	Berlin	B. D. − 7° 5847	I	−0.82	+0.57	+0.46	−0.15	−0.48	−0.22	+0.35	+0.22	−0.85	−1.4	+0.3
13	Berlin	B. D. − 7° 5858	I	−0.84	+0.58	−0.42	+0.14	+0.44	+0.15	+0.46	−0.11	−0.87	−2.9	−1.2
13	Berlin	B. D. − 7° 5861	I	−0.89	+0.62	−0.27	+0.09	+0.28	+0.08	+0.48	−0.05	−0.93	−2.8	−1.0
13	Berlin	B. D. − 7° 5866	I	−0.44	+0.31	−0.85	+0.28	+0.89	+0.37	+0.31	−0.29	−0.46	−2.1	−1.2
15	Berlin	B. D. + 3° 10	I	−0.53	+0.54	+0.61	−0.53	−0.81	−0.34	+0.17	+0.01	−0.46	−1.4	−0.3
15	Berlin	B. D. + 3° 15	I	−0.90	+0.92	+0.04	−0.03	−0.05	−0.03	+0.45	+0.05	−0.78	−3.5	−1.7
15	Berlin	B. D. + 4° 22	I	−0.78	+0.80	+0.37	−0.33	−0.49	−0.23	+0.35	+0.02	−0.68	−1.1	+0.5
16	Berlin	B. D. + 8° 126	I	−0.80	+0.88	−0.25	+0.34	+0.42	+0.19	+0.43	+0.14	−0.58	−1.9	−0.3
16	Berlin	B. D. + 9° 110	I	−0.83	+0.91	+0.21	−0.29	−0.36	−0.16	+0.37	−0.04	−0.60	−2.4	−0.7
16	Berlin	B. D. + 9° 109	I	−0.51	+0.56	+0.48	−0.66	−0.82	−0.36	+0.17	−0.17	−0.36	−1.1	−0.1
16	Berlin	B. D. +10° 123	I	−0.63	+0.70	+0.40	−0.59	−0.71	−0.30	+0.23	−0.15	−0.45	−1.2	+0.1
17	Berlin	104 Piscium	I	−0.44	+0.50	−0.37	+0.78	+0.87	+0.35	+0.28	+0.38	−0.24	−1.8	−0.9
26	Berlin	B. D. +13° 2131	E	+1.06	+0.55	−0.09	0.00	−0.09	+0.21	+0.38	−0.13	−0.99	+0.8	−1.0
26	Berlin	47 B. Leonis	E	+0.99	+0.51	+0.36	−0.01	+0.36	+0.02	+0.40	+0.16	−0.92	+1.3	−0.4
26	Berlin	B. D. +13° 2139	E	+0.90	+0.47	+0.52	−0.02	+0.52	−0.06	+0.39	+0.27	−0.84	+2.3	+0.8
26	Berlin	B. D. +13° 2147	E	+0.64	+0.33	+0.80	−0.04	+0.80	−0.21	+0.33	+0.45	−0.59	+2.2	+1.1
Dec. 16	Berlin	B. D. +22° 438	I	−0.82	+0.82	0.00	−0.40	−0.40	−0.12	+0.25	−0.25	−0.54	−4.2	−2.5
17	Berlin	17 Tauri	I	−0.88	+0.85	+0.04	+0.21	+0.21	+0.03	+0.21	+0.23	−0.46	−2.4	−0.6
17	Berlin	20 Tauri	I	−0.79	+0.77	−0.08	−0.47	−0.48	−0.10	+0.17	−0.36	−0.41	−2.9	−1.2
17	Berlin	q Tauri	I	−0.23	+0.23	−0.16	−0.95	−0.97	−0.18	+0.03	−0.81	−0.12	−1.7	−1.2
17	Berlin	B. D. +23° 523	I	−0.89	+0.86	+0.02	+0.13	+0.13	+0.02	+0.22	+0.16	−0.47	−3.3	−1.4
17	Berlin	B. D. +24° 562	I	−0.66	+0.64	−0.12	−0.68	−0.69	−0.14	+0.14	−0.54	−0.34	−1.4	0.0
17	Berlin	B. D. +23° 540	I	−0.86	+0.83	+0.06	+0.31	+0.32	+0.04	+0.20	+0.32	−0.45	−0.8	+1.0
17	Berlin	B. D. +24° 566	I	−0.54	+0.52	−0.14	−0.78	−0.80	−0.17	+0.11	−0.65	−0.28	−1.9	−0.8
17	Berlin	B. D. +23° 553	I	−0.82	+0.79	+0.08	+0.40	+0.41	+0.07	+0.19	+0.39	−0.43	−2.1	−0.4
17	Berlin	B. D. +23° 560	I	−0.79	+0.77	+0.09	+0.45	+0.46	+0.08	+0.18	+0.44	−0.41	−2.5	−0.8
17	Berlin	B. D. +23° 561	I	−0.75	+0.72	+0.11	+0.55	+0.56	+0.09	+0.19	+0.52	−0.39	−3.0	−1.4
17	Berlin	B. D. +23° 567	I	−0.33	+0.32	+0.18	+0.91	+0.93	+0.18	−0.09	+0.81	−0.17	−1.6	−0.9
17	Berlin	B. D. +24° 578	I	−0.80	+0.77	+0.09	+0.45	+0.46	+0.07	+0.18	+0.44	−0.42	−2.2	−0.5
17	Berlin	B. D. +24° 602	I	−0.89	+0.86	−0.02	−0.11	−0.11	−0.03	+0.20	−0.04	−0.47	−3.7	−1.8
17	Greenwich	η Tauri	I	−0.48	+0.45	+0.15	+0.84	+0.86	+0.25	+0.14	+0.75	−0.24	−2.2	−1.2
18	Berlin	B. D. +26° 775	I	−0.91	+0.75	+0.05	+0.11	+0.12	−0.02	+0.06	+0.18	−0.39	−2.4	−0.5
1897, Jan. 7	Berlin	252 B. Aquarii	I	−0.92	+0.59	+0.13	−0.05	−0.14	−0.11	+0.43	+0.11	−0.78	−3.9	−2.0
10	Berlin	B. D. +10° 128	I	−0.89	+0.97	−0.05	+0.08	+0.09	+0.03	+0.43	+0.10	−1.00	−4.3	−2.4
10	Berlin	B. D. +11° 146	I	−0.10	+0.11	+0.50	−0.87	−1.00	−0.42	−0.06	−0.29	−0.11	+0.5	+0.7
10	Berlin	B. D. +11° 152	I	−0.85	+0.92	+0.16	−0.28	−0.32	−0.12	+0.36	−0.02	−0.95	−3.1	−1.3
11	Santiago	15 Arietis	I	−0.89	+1.00	+0.02	−0.09	−0.09	−0.04	+0.35	−0.11	−0.98	−1.6	+0.3
17	Cape	A Geminor.	I	−0.52	+0.10	+0.77	+0.41	+0.88	−0.27	−0.07	+0.86	−0.04	+1.0	+2.1
23	Cape	χ Virginis	E	+0.30	+0.25	−0.56	+0.80	−0.96	+0.48	+0.01	+0.16	−0.26	−0.1	−0.6
27	Cape	α Scorpii	IB	−0.46	−0.36	−0.34	−0.84	+0.91	−0.19	−0.04	−0.81	+0.37	−1.9	−0.9
27	Cape	α Scorpii	E	+0.81	+0.64	−0.25	−0.63	+0.68	+0.08	+0.11	−0.67	−0.64	+2.9	+1.5
Feb. 13	Cape	39 Geminor.	I	−0.29	+0.10	+0.81	+0.50	+0.95	−0.17	−0.04	+0.94	−0.18	−0.7	−0.1
23	Cape	α Scorpii	E	+1.09	+0.89	−0.04	−0.08	+0.09	+0.20	+0.14	−0.13	−1.00	−1.0	−2.9
Apr. 12	Kasan	19 Leonis	I	−1.00	−0.23	−0.24	+0.05	−0.25	−0.07	−0.35	−0.35	−0.55	−1.0	+1.2
14	Cape	79 Leonis	I	−1.06	−0.65	+0.10	−0.08	+0.14	−0.25	−0.44	+0.07	−0.17	−1.5	+0.8
19	Cape	σ Scorpii	E	+1.03	+0.89	−0.14	−0.31	+0.35	+0.15	+0.14	−0.37	−0.54	+2.6	+0.7
May 5	Cape	136 Tauri	I	−0.80	+0.61	−0.37	−0.34	−0.50	−0.02	−0.04	−0.44	−0.64	−1.3	+0.5
11	Santiago	75 Leonis	I	−0.64	−0.36	−0.63	+0.49	−0.80	+0.26	−0.36	−0.11	−0.50	−2.3	−0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1897, July 3	Cape	18 Leonis	I	−0.48	−0.07	+0.85	−0.26	+0.88	−0.41	−0.11	+0.56	−0.35	−0.4	+0.7
12	Cape	λ Sagittarii	I	−0.60	−0.43	+0.70	+0.43	−0.82	−0.18	+0.05	+0.85	−0.18	−0.2	+1.2
13	Greenwich	χ Sagittarii	I	−0.94	−0.55	+0.49	+0.17	−0.52	−0.28	+0.17	+0.55	−0.12	+1.6	+3.8
20	Santiago	η Piscium	IB	−0.89	+0.76	−0.05	+0.21	+0.22	+0.06	+0.40	+0.17	+0.86	−0.6	+1.5
20	Santiago	η Piscium	E	+0.77	−0.66	−0.11	+0.54	+0.55	+0.23	−0.28	+0.17	−0.74	+3.6	+2.1
23	Greenwich	17 Tauri	IB	−0.84	+0.94	−0.13	−0.33	−0.35	−0.08	+0.19	−0.24	+0.85	−1.4	+0.5
23	Greenwich	16 Tauri	IB	−0.13	+0.15	−0.35	−0.92	−0.99	−0.18	+0.01	−0.82	+0.14	+0.6	+0.9
23	Greenwich	16 Tauri	E	+0.29	−0.32	−0.34	−0.88	−0.95	−0.16	−0.09	−0.82	−0.29	+1.1	+0.5
23	Greenwich	23 Tauri	IB	−0.66	+0.73	+0.24	+0.63	+0.68	+0.11	+0.16	+0.62	+0.66	−1.7	−0.2
23	Greenwich	17 Tauri	E	+0.89	−0.98	−0.06	−0.16	−0.17	−0.02	−0.20	−0.22	−0.88	+2.6	+0.9
23	Greenwich	η Tauri	IB	−0.84	+0.93	+0.13	+0.33	+0.36	+0.06	+0.20	+0.37	+0.84	−0.6	+1.4
23	Greenwich	23 Tauri	E	+0.52	−0.57	+0.30	+0.76	+0.82	+0.17	−0.10	+0.66	−0.51	+0.7	−0.3
23	Greenwich	24 Tauri	E	+0.79	−0.87	+0.19	+0.46	+0.49	+0.10	−0.16	+0.36	−0.78	+0.2	−1.3
23	Greenwich	η Tauri	E	+0.74	−0.82	+0.22	+0.53	+0.57	+0.11	−0.15	+0.42	−0.74	+1.6	+0.2
23	Greenwich	28 Tauri	IB	−0.60	+0.67	+0.28	+0.69	+0.74	+0.13	+0.14	+0.68	+0.60	+0.3	+1.7
23	Greenwich	28 Tauri	E	+0.40	−0.45	+0.34	+0.83	+0.89	+0.15	−0.07	+0.73	−0.40	+0.3	−0.5
23	Greenwich	105 B. Tauri	E	+0.90	−1.00	−0.02	−0.04	−0.04	0.00	−0.20	−0.11	−0.90	−1.0	−2.7
Aug. 1	Santiago	359 B. Leonis	I	−1.04	−0.46	−0.03	+0.04	−0.05	−0.13	−0.46	+0.07	+0.99	−4.3	−1.9
4	Greenwich	89 Virginis	I	−0.86	−0.74	+0.05	−0.59	+0.59	−0.35	−0.26	−0.22	−0.80	−0.4	+1.6
4	Cape	83 Virginis	I	−1.06	−0.88	−0.03	+0.26	−0.26	−0.12	−0.37	+0.20	−0.95	−0.1	+2.3
9	Evanston	χ Sagittarii	I	−0.92	−0.56	−0.49	−0.18	+0.52	−0.06	+0.18	−0.43	−0.48	−1.2	+0.9
14	Evanston	λ Piscium	IB	−0.72	+0.31	+0.46	−0.50	−0.68	−0.37	+0.26	+0.11	+0.37	−5.1	−3.4
17	Santiago	ι Arietis	E	+0.90	−0.81	−0.01	+0.18	+0.18	+0.07	−0.35	+0.10	+0.97	+1.1	−0.6
Sept. 9	Cape	ρ Aquarii	I	−0.77	−0.04	−0.56	+0.30	+0.64	+0.17	+0.39	−0.24	−0.28	−2.7	−0.9
18	Cape	136 Tauri	E	+0.28	−0.27	−0.77	−0.56	−0.95	+0.05	+0.01	−0.96	−0.31	+0.9	+0.4
Oct. 1	Cape	A Ophiuchi	I	−1.09	−0.96	−0.14	−0.14	+0.20	−0.23	−0.02	−0.12	−0.88	−0.8	+1.8
3	Evanston	53 Sagittarii	I	−1.04	−0.69	+0.04	−0.01	−0.04	−0.16	+0.24	+0.11	−0.99	−0.7	+1.8
3	Greenwich	48 Sagittarii	I	−0.99	−0.73	−0.32	−0.08	+0.33	−0.08	+0.21	−0.25	−0.94	−1.9	+0.5
3	Greenwich	χ Sagittarii	I	−0.78	−0.58	−0.64	−0.16	+0.66	+0.03	+0.18	−0.57	−0.75	−2.2	−0.3
8	Cape	16 Piscium	I	−0.62	+0.16	+0.49	−0.60	−0.77	−0.38	+0.19	+0.13	−0.32	+0.8	+2.3
30	Evanston	49 Sagittarii	I	−0.71	−0.51	−0.73	−0.16	+0.75	+0.04	+0.16	−0.65	−0.61	−3.1	−1.4
Nov. 4	Cape	κ Piscium	I	−0.97	+0.16	+0.07	−0.08	−0.11	−0.14	+0.42	+0.11	−0.84	−0.8	+1.5
4	Cape	9 Piscium	I	−0.81	+0.13	−0.35	+0.43	+0.56	+0.17	+0.43	0.00	−0.71	−3.0	−1.0
Dec. 2	Kasan	22 Piscium	I	−0.56	+0.11	−0.42	+0.69	+0.81	+0.32	+0.34	0.00	−0.58	−1.5	−0.1
5	Cape	θ Arietis	I	−0.90	+0.21	−0.05	−0.36	−0.36	−0.19	+0.28	−0.14	−0.62	−1.9	+0.3
5	Evanston	26 Arietis	I	−0.42	+0.40	−0.14	−0.87	−0.88	−0.25	+0.10	−0.52	−0.28	−0.5	+0.5
6	Kasan	ε Arietis	I	−0.90	+0.89	−0.02	−0.07	−0.07	−0.03	+0.25	0.00	−0.54	−1.7	+0.5
7	Kasan	27 Tauri	I	−0.48	+0.50	−0.41	−0.74	−0.85	−0.15	+0.07	−0.69	−0.18	−1.0	+0.2
13	Cape	π Cancri	E	+0.91	−0.30	+0.30	−0.09	+0.31	−0.04	+0.38	+0.14	−0.82	+2.8	+0.9
25	Evanston	ο Capricor.	I	−0.03	−0.02	+0.99	−0.11	−1.00	−0.31	−0.05	+0.82	−0.01	+1.4	+1.5
27	Evanston	θ Aquarii	I	−0.42	−0.10	+0.77	−0.51	−0.92	−0.45	+0.08	+0.45	−0.31	+2.1	+3.1
1898, Jan. 2	Kasan	ε Arietis	I	−0.31	+0.32	+0.32	+0.88	+0.94	+0.22	+0.11	+0.70	−0.31	−1.3	−0.5
3	Greenwich	17 Tauri	I	−0.76	+0.82	−0.26	−0.46	−0.53	−0.10	+0.15	−0.39	−0.61	−1.5	+0.4
3	Greenwich	24 Tauri	I	−0.90	+0.96	+0.04	+0.07	+0.08	0.00	+0.19	+0.15	−0.72	−5.2	−2.9
3	Greenwich	23 Tauri	I	−0.78	+0.84	+0.25	+0.42	+0.49	+0.08	+0.17	+0.49	−0.63	−3.4	−1.4
3	Greenwich	17 Tauri	EB	+0.85	−0.90	−0.17	−0.28	−0.33	−0.05	−0.18	−0.36	+0.68	+1.2	−0.6
3	Greenwich	η Tauri	I	−0.89	+0.95	+0.08	+0.13	+0.15	+0.02	+0.18	+0.26	−0.71	−3.2	−1.0
3	Greenwich	23 Tauri	EB	+0.70	−0.75	+0.32	+0.54	+0.63	+0.10	−0.13	+0.46	+0.56	+2.5	+1.0
3	Greenwich	105 B. Tauri	I	−0.74	+0.79	−0.30	−0.49	−0.57	−0.09	+0.13	−0.41	−0.59	−3.7	−1.8
3	Greenwich	28 Tauri	I	−0.84	+0.89	+0.19	+0.32	+0.37	+0.05	+0.17	+0.41	−0.67	−3.2	−1.1
3	Greenwich	27 Tauri	I	−0.64	+0.68	+0.36	+0.60	+0.70	+0.11	+0.14	+0.66	−0.51	−1.2	+0.4
3	Greenwich	η Tauri	EB	+0.87	−0.93	+0.12	+0.20	+0.24	+0.04	−0.17	+0.12	+0.70	+2.3	+0.5
3	Greenwich	27 Tauri	EB	+0.64	−0.69	+0.37	+0.60	+0.70	+0.11	−0.11	+0.53	+0.52	−1.6	−2.9
5	Evanston	125 Tauri	I	−0.75	+0.80	−0.46	−0.32	−0.56	+0.01	−0.02	−0.48	−0.28	−2.5	−0.6
10	Cape	18 Leonis	E	+0.95	−0.25	−0.18	+0.09	−0.20	+0.16	+0.38	−0.19	−0.63	+2.7	+0.7
10	Cape	19 Leonis	E	+0.96	−0.25	+0.11	−0.06	+0.12	+0.03	+0.40	0.00	−0.63	+3.4	+1.4
26	Evanston	45 Piscium	I	−0.58	+0.19	−0.28	+0.76	+0.81	+0.29	+0.33	+0.17	−0.50	−1.6	−0.1
Feb. 5	Evanston	o^2 Cancri	I	−0.95	+0.48	+0.05	−0.01	+0.05	−0.07	−0.35	+0.12	+0.01	−3.5	−1.1
13	Cape	42 Libræ	E	+0.99	+0.85	+0.23	+0.39	−0.45	+0.27	+0.15	+0.30	−0.89	+1.5	−0.6
25	Cape	θ Arietis	I	−0.84	+0.77	+0.08	+0.37	+0.38	+0.10	+0.31	+0.32	−0.77	−1.9	+0.2
25	Evanston	26 Arietis	I	−0.93	+0.78	0.00	+0.01	+0.01	−0.04	+0.31	+0.08	−0.90	−1.8	+0.5
Mar. 1	Kasan	125 Tauri	I	−0.20	+0.24	−0.84	−0.50	−0.98	+0.02	0.00	−0.95	−0.23	−1.3	−0.8
2	Cape	ε Geminor.	I	−0.86	+0.89	+0.26	+0.07	+0.27	−0.04	−0.13	+0.33	−0.82	−0.8	+1.4
5	Cape	π Cancri	I	−0.82	+0.44	−0.45	+0.17	−0.48	+0.13	−0.35	−0.27	−0.36	−4.4	−2.3
13	Greenwich	α Scorpii	IB	−1.07	−0.97	−0.07	−0.07	+0.10	−0.17	−0.10	+0.19	+0.97	−1.4	+1.4
13	Greenwich	α Scorpii	E	+1.04	+0.92	+0.21	+0.22	−0.30	+0.21	+0.10	+0.18	−0.92	+4.8	+2.5
13	Pola	α Scorpii	IB	−1.05	−0.95	+0.12	+0.13	−0.18	−0.14	−0.10	+0.25	+0.95	−0.8	+1.9
13	Strassburg	α Scorpii	I	−1.06	−0.95	+0.12	+0.12	−0.17	−0.16	−0.10	+0.25	+0.95	−0.9	+1.8
13	Strassburg	α Scorpii	E	+1.01	+0.92	+0.24	+0.24	−0.34	+0.19	+0.09	+0.21	−0.91	+4.8	+2.6
13	Prague	α Scorpii	IB	−1.03	−0.93	+0.21	+0.22	−0.30	−0.14	−0.10	+0.32	+0.93	−1.4	+1.3

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1898, Mar. 13	Prague	α Scorpii	E	+0.98	+0.88	+0.28	+0.29	-0.40	+0.19	+0.09	+0.31	-0.88	+4.9	+2.7
17	Cape	ρ Capricor.	E	+0.80	+0.57	+0.66	-0.11	-0.67	-0.07	-0.27	+0.59	-0.61	+2.2	+0.4
26	Kasan	9 Tauri	I	-0.90	+0.86	+0.11	+0.17	+0.20	+0.02	+0.19	+0.24	-0.75	-0.8	+1.5
Apr. 1	Kasan	54 Cancri	I	-0.75	+0.55	+0.58	-0.17	+0.60	-0.22	-0.39	+0.53	-0.73	-2.6	-0.6
2	Evanston	10 Sextantis	I	-0.85	+0.26	+0.40	-0.26	+0.48	-0.26	-0.32	+0.33	-0.52	-3.2	-1.0
4	Kasan	p^5 Leonis	I	-0.95	0.00	-0.21	+0.29	-0.36	+0.05	-0.45	-0.02	-0.33	-5.0	-2.5
25	Cape	139 Tauri	I	-0.73	+0.57	+0.55	+0.25	+0.60	-0.05	-0.05	+0.66	-0.64	-1.2	+0.7
28	Cape	θ Cancri	I	-0.62	+0.06	+0.76	-0.17	+0.78	-0.28	-0.14	+0.68	-0.63	-1.3	+0.3
29	Greenwich	ξ Leonis	I	-0.32	+0.16	-0.83	+0.45	-0.94	+0.34	-0.20	-0.57	-0.32	-1.5	-0.7
May 2	Greenwich	13 B. Virginis	I	-0.61	-0.09	+0.32	+0.75	+0.81	-0.43	-0.17	+0.08	-0.34	-1.5	+0.1
16	Cape	75 Piscium	E	+0.97	-0.25	0.00	-0.02	-0.02	+0.07	-0.38	-0.10	-0.67	+2.3	+0.1
June 5	Greenwich	λ Sagittarii	E	+1.13	+0.98	+0.18	+0.05	-0.19	+0.22	-0.12	+0.11	-0.31	+5.4	+2.8
6	Cape	50 Sagittarii	E	+1.02	+0.89	-0.35	-0.01	+0.35	+0.26	-0.20	-0.40	-0.47	+2.8	+0.5
13	Cape	105 Piscium	E	+0.83	-0.31	-0.07	-0.50	-0.50	-0.09	-0.22	-0.37	-0.76	+1.5	-0.4
30	Cape	42 Libræ	I	-0.85	+0.67	-0.39	-0.50	+0.63	-0.27	-0.12	-0.46	-0.47	-0.5	+1.8
30	Kasan	λ Sagittarii	I	-1.13	-0.99	-0.10	-0.02	+0.11	-0.23	+0.13	+0.06	-0.52	-1.8	+1.3
Aug. 6	Cape	75 Piscium	E	+0.16	-0.02	+0.13	+0.99	+0.99	+0.38	+0.02	+0.29	-0.14	+1.6	+1.2
25	Cape	26 Ophiuchi	I	-0.36	-0.31	+0.83	+0.47	-0.95	-0.04	-0.03	+0.94	-0.32	+0.4	+1.4
Sept. 3	Cape	η Piscium	E	+0.97	-0.14	+0.02	+0.13	+0.13	+0.12	-0.34	-0.04	-0.59	+2.2	-0.1
23	Cape	ν^1 Sagittarii	I	-1.02	-0.92	-0.39	-0.02	+0.39	-0.13	+0.16	-0.31	-0.90	0.0	+2.8
23	Cape	ν^2 Sagittarii	I	-1.01	-0.91	-0.41	-0.02	+0.41	-0.12	+0.17	-0.32	-0.89	-0.1	+2.7
28	Greenwich	16 Piscium	I	-1.01	-0.37	+0.09	-0.27	-0.28	-0.26	+0.38	+0.05	-0.30	-0.1	+2.7
Oct. 20	Cape	23 Sagittarii	I	-0.69	-0.61	+0.78	+0.09	-0.79	-0.23	+0.06	+0.82	-0.57	-0.7	+1.3
24	Cape	51 Aquarii	I	-1.07	-0.70	+0.04	-0.05	-0.07	-0.20	+0.40	+0.12	-0.88	+0.4	+3.4
Nov. 16	Cape	1 Sagittarii	I	-1.08	-0.93	-0.18	-0.03	+0.18	-0.17	+0.09	-0.10	-0.59	-3.0	-0.8
22	Greenwich	19 Piscium	I	-0.77	-0.36	+0.16	-0.63	-0.65	-0.35	+0.26	+0.11	-0.71	+0.5	+2.7
22	Wilhelmshaven	19 Piscium	I	-0.84	-0.40	+0.13	-0.54	-0.56	-0.01	+0.29	+0.11	-0.78	+1.4	+3.8
22	Kasan	19 Piscium	I	-1.02	-0.48	+0.01	-0.05	-0.05	-0.13	+0.40	+0.08	-0.94	-0.1	+2.8
Dec. 19	Kasan	κ Piscium	I	-1.04	-0.59	+0.01	-0.03	-0.03	-0.15	+0.41	+0.06	-0.97	-2.6	+0.4
23	Kasan	47 Arietis	I	-0.91	+0.30	+0.16	+0.20	+0.26	+0.02	+0.22	+0.25	-0.76	-1.4	+1.2
23	Greenwich	47 Arietis	I	-0.82	+0.27	+0.31	+0.40	+0.51	+0.08	+0.22	+0.43	-0.68	-3.2	-0.8
30	Cape	o^1 Cancri	E	+0.40	-0.42	-0.76	+0.49	-0.90	+0.30	+0.09	-0.70	-0.24	-0.2	-1.2
1899, Jan. 19	Greenwich	μ Arietis	I	-0.82	+0.14	-0.30	-0.41	-0.51	-0.16	+0.21	-0.27	-0.85	-0.7	+1.7
Feb. 2	Cape	43 H. Virginis	E	+0.70	+0.11	-0.35	-0.61	+0.70	-0.14	+0.25	-0.47	-0.71	+1.7	-0.1
4	Cape	27 G. Scorpii	E	+0.90	+0.49	-0.44	-0.29	+0.53	+0.06	+0.11	-0.54	-0.77	+2.6	+0.3
18	Kasan	103 Tauri	I	-0.54	+0.40	-0.77	-0.26	-0.81	-0.02	+0.01	-0.74	-0.57	-1.0	+0.6
19	Kasan	1 Geminor.	I	-0.77	+0.71	+0.52	+0.06	+0.53	-0.04	-0.07	+0.60	-0.76	-5.3	-3.0
21	Cape	79 Geminor.	I	-0.89	+0.99	+0.11	-0.03	+0.11	-0.02	-0.24	+0.19	-0.61	-3.1	-0.5
22	Greenwich	90 B. Cancri	I	-0.81	+0.89	+0.38	-0.22	+0.44	-0.13	-0.26	+0.44	-0.40	-2.7	-0.4
Mar. 16	Cape	26 Tauri	I	-0.97	+0.45	-0.04	-0.03	-0.05	-0.06	+0.15	+0.06	-0.84	-3.2	-0.3
16	Cape	27 Tauri	I	-0.46	+0.22	-0.72	-0.51	-0.88	-0.15	+0.06	-0.70	-0.40	-0.8	-0.6
20	Kasan	56 Geminor.	I	-0.81	+0.86	-0.42	+0.10	-0.43	+0.09	-0.21	-0.34	-0.86	-4.1	-1.7
Apr. 15	Wilhelmshaven	η Geminor.	I	-0.09	+0.07	+1.00	+0.01	+1.00	-0.01	0.00	+1.00	-0.08	-0.8	-5.8
17	Wilhelmshaven	3 Cancri	I	-0.50	+0.55	+0.75	-0.35	+0.83	+0.03	-0.12	+0.80	-0.56	-2.8	-1.3
17	Greenwich	3 Cancri	I	-0.21	+0.24	+0.88	-0.41	+0.97	-0.24	-0.03	+0.88	-0.24	-0.1	+0.6
19	Wilhelmshaven	h Leonis	I	-0.80	+0.84	+0.31	-0.35	+0.47	+0.06	-0.30	+0.38	-0.80	-3.4	-1.0
19	Kasan	h Leonis	I	-0.90	+0.95	-0.10	+0.11	-0.14	+0.05	-0.39	-0.01	-0.89	-5.0	-2.3
28	Pola	θ Ophiuchi	IB	-1.06	-0.73	+0.03	+0.01	-0.03	-0.15	+0.02	+0.11	+0.73	-2.4	+0.8
28	Pola	θ Ophiuchi	E	+1.05	+0.72	+0.12	+0.03	-0.12	+0.15	-0.01	+0.02	-0.72	+4.2	+1.4
May 1	Cape	31 B. Capricor.	E	+1.06	+0.98	+0.16	-0.10	-0.19	+0.11	-0.31	+0.07	-0.97	-0.4	-3.3
3	Cape	44 Aquarii	E	+1.03	+0.87	+0.14	-0.24	-0.28	+0.04	-0.40	+0.05	-0.90	+3.5	+0.7
12	Cape	132 Tauri	I	-0.66	+0.52	-0.71	-0.06	-0.71	+0.02	-0.05	-0.64	-0.38	-2.1	-0.1
26	Greenwich	9 Sagittarii	E	+1.08	+0.77	+0.22	0.00	-0.22	+0.17	-0.08	+0.12	-0.45	+0.1	-2.8
June 13	Cape	o Leonis	I	-0.59	+0.64	-0.45	+0.61	-0.76	+0.29	-0.30	-0.42	-0.58	-5.7	-3.9
25	Cape	τ Capricor.	E	+1.11	+0.98	-0.11	+0.09	+0.14	+0.26	-0.31	-0.22	-0.50	+2.2	-0.9
July 18	Cape	δ Scorpii	I	-0.06	-0.02	+0.90	+0.44	-1.00	+0.11	-0.02	+0.87	-0.04	+1.5	+1.7
18	Cape	δ Scorpii	EB	+0.28	+0.08	+0.87	+0.42	-0.96	+0.14	+0.03	+0.80	+0.20	+1.9	+1.1
20	Kasan	7 Sagittarii	I	-1.04	-0.68	+0.39	-0.01	-0.39	-0.23	+0.08	+0.47	-0.38	-1.0	+2.2
Aug. 26	Cape	66 Arietis	E	+0.56	-0.04	-0.70	-0.43	-0.82	-0.10	-0.11	-0.71	-0.54	+2.3	+0.7
27	Cape	62 Tauri	E	+0.89	-0.27	-0.36	-0.12	-0.38	+0.01	-0.08	-0.45	-0.91	+2.9	+0.4
Oct. 11	Cape	36 Sagittarii	I	-1.03	-0.72	+0.17	-0.06	-0.18	-0.16	+0.17	+0.28	-0.98	-0.4	+2.9
12	Kasan	57 Sagittarii	I	-1.04	+0.87	-0.18	+0.11	+0.21	-0.09	+0.23	-0.12	-0.97	+0.7	+4.0
27	Cape	o Leonis	E	+0.90	-1.00	+0.01	-0.01	+0.01	-0.02	+0.36	-0.06	-0.98	+4.8	+2.1
Nov. 11	Cape	187 B. Aquarii	I	-1.01	-0.92	+0.09	-0.35	-0.36	-0.29	+0.34	+0.25	-0.88	-0.5	+2.8
13	Cape	36 Piscium	I	-0.98	-0.72	-0.10	-0.42	-0.43	-0.31	+0.31	+0.05	-0.68	-0.1	+3.1
14	Cape	75 Piscium	I	-0.41	-0.24	-0.42	-0.83	-0.93	-0.38	+0.07	-0.25	-0.24	+2.4	+3.7
18	Cape	99 Tauri	E	+0.99	+0.25	-0.11	-0.01	-0.11	+0.07	-0.03	-0.19	-0.20	+3.9	+0.9
Dec. 8	Cape	138 B. Aquarii	I	-0.67	-0.62	+0.24	-0.75	-0.79	-0.40	+0.18	+0.43	-0.60	+0.6	+2.8
13	Cape	μ Arietis	I	-0.98	-0.32	-0.24	-0.18	-0.30	-0.17	+0.22	-0.10	-0.68	-1.1	+2.1
16	Greenwich	175 H^1. Tauri	I	-0.88	+0.26	-0.44	+0.04	-0.44	-0.02	-0.04	-0.36	-0.04	-2.7	+0.2

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	l_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1899, Dec. 16	Greenwich	175 H[1]. Tauri	E	+0.81	−0.24	−0.56	+0.05	−0.56	+0.07	+0.04	−0.62	+0.03	−0.5	−3.0
1900, Jan. 9	Greenwich	27 Arietis	I	−0.51	−0.24	+0.69	+0.55	+0.88	+0.16	+0.14	+0.58	−0.46	−3.0	−1.3
11	Wilhelmshaven	67 Tauri	I	−0.71	−0.05	+0.67	+0.14	+0.69	−0.05	+0.07	+0.68	−0.54	−4.7	−2.4
23	Cape	40 H. Virginis	E	+0.57	−0.32	+0.58	+0.55	−0.80	+0.23	+0.14	+0.41	−0.59	+2.3	+0.5
Feb. 3	Cape	d Piscium	I	−0.68	−0.54	+0.26	+0.74	+0.79	+0.18	+0.29	+0.13	−0.46	−1.8	+0.4
6	Wilhelmshaven	δ Arietis	I	−0.81	−0.34	+0.54	+0.28	+0.60	−0.06	+0.16	+0.51	−0.80	−2.3	+0.4
6	Greenwich	δ Arietis	I	−0.73	−0.27	+0.66	+0.34	+0.74	+0.07	+0.14	+0.60	−0.68	−1.9	+0.5
7	Greenwich	39 Tauri	I	−0.76	−0.13	−0.69	−0.18	−0.71	−0.13	+0.07	−0.56	−0.70	−2.3	+0.2
12	Cape	90 B. Cancri	I	−0.91	+0.84	+0.01	−0.01	+0.01	+0.01	−0.30	+0.10	−0.33	−4.7	−1.7
Mar. 5	Wilhelmshaven	40 Arietis	I	−0.82	−0.43	+0.55	+0.34	+0.64	−0.09	+0.19	+0.48	−0.62	−3.0	−0.3
7	Cape	300 B. Tauri	I	−0.58	0.00	−0.81	−0.05	−0.81	−0.08	+0.03	−0.72	−0.57	−1.8	+0.1
8	Cape	394 B. Tauri	I	−0.95	+0.23	+0.18	−0.03	+0.18	−0.05	−0.05	+0.27	−0.98	−4.9	−1.7
23	Cape	14 Sagittarii	E	+0.97	+0.30	−0.30	+0.09	+0.31	+0.12	+0.09	−0.39	−0.93	+2.2	−0.9
26	Cape	ν Aquarii	E	+1.00	+0.78	+0.22	−0.38	−0.44	+0.02	−0.31	+0.23	−0.64	+3.3	+0.1
Apr. 2	Cape	τ Arietis	I	−1.05	−0.36	−0.21	−0.08	−0.22	−0.19	+0.17	−0.08	−0.57	−2.9	+0.6
4	Greenwich	o Tauri	I	−1.02	+0.03	−0.34	+0.04	−0.34	−0.07	−0.02	−0.25	−0.84	−4.1	−0.7
5	Cape	η Geminor.	I	−0.96	+0.29	−0.18	+0.06	−0.19	−0.04	−0.10	−0.10	−0.92	−5.1	−1.8
May 1	Wilhelmshaven	ι Tauri	I	−1.02	−0.14	+0.20	−0.01	+0.20	−0.11	+0.02	+0.26	−0.50	−5.4	−1.9
7	Greenwich	19 Sextantis	I	−0.86	+0.91	+0.05	−0.28	+0.28	+0.07	−0.33	+0.23	−0.93	−5.4	−2.5
16	Cape	52 Ophiuchi	E	+0.94	+0.07	+0.34	−0.07	−0.35	+0.06	−0.04	−0.28	−0.56	+2.3	−0.8
16	Cape	158 G. Ophiuchi	E	+0.73	+0.08	+0.67	−0.16	−0.69	+0.03	−0.04	−0.27	−0.54	+5.1	+2.7
16	Cape	58 Ophiuchi	E	+0.99	+0.06	−0.19	+0.04	+0.19	+0.09	−0.04	+0.62	−0.41	+3.9	+0.6
20	Cape	19 Aquarii	E	+1.04	+0.84	+0.09	−0.20	−0.22	+0.06	−0.35	+0.05	−0.93	+3.1	−0.3
June 2	Greenwich	κ Cancri	I	−0.92	+0.07	+0.10	−0.20	+0.22	+0.06	−0.30	+0.18	+0.24	−5.0	−1.8
8	Cape	550 B. Virginis	I	−0.53	+0.48	+0.57	+0.59	−0.82	+0.25	−0.22	+0.39	−0.42	−1.9	0.0
14	Cape	45 Sagittarii	E	+0.81	+0.34	+0.50	−0.40	−0.64	−0.03	−0.17	+0.55	−0.39	+2.9	+0.2
July 6	Cape	40 H. Virginis	I	−0.90	+0.75	−0.18	−0.12	+0.22	−0.05	−0.25	−0.05	−0.89	−4.2	−1.0
10	Cape	58 Ophiuchi	I	−0.98	+0.03	+0.30	−0.08	−0.31	−0.11	+0.03	+0.39	−0.31	−2.6	+0.8
11	Greenwich	ξ Sagittarii	I	−0.98	−0.31	−0.42	+0.28	+0.50	−0.04	+0.14	−0.42	−0.05	−3.5	−0.1
Aug. 7	Cape	μ Sagittarii	I	−1.04	−0.04	+0.01	−0.01	−0.01	−0.12	+0.09	+0.10	−0.62	−4.1	−0.5
8	Cape	d Sagittarii	I	−1.00	−0.28	−0.28	+0.22	+0.35	−0.07	+0.18	−0.27	−0.40	−2.8	+0.7
17	Cape	A Tauri	E	+0.64	+0.30	−0.78	−0.08	−0.78	−0.02	−0.08	−0.74	−0.62	+3.3	+1.2
Sept. 1	Cape	ω^2 Scorpii	I	−0.80	+0.41	+0.53	+0.03	−0.53	+0.04	−0.10	+0.53	−0.85	−1.3	+1.5
2	Cape	116 B. Ophiuchi	I	−0.96	+0.25	+0.14	−0.03	−0.14	−0.04	−0.07	+0.22	−0.96	−2.7	+0.7
4	Cape	171 B. Sagittarii	I	−0.55	−0.11	−0.67	+0.52	+0.85	+0.07	+0.11	−0.77	−0.41	−3.6	−1.7
4	Greenwich	36 Sagittarii	I	−1.04	−0.31	−0.26	−0.19	−0.32	−0.15	+0.14	+0.38	−0.74	−4.9	−1.3
4	Greenwich	36 Sagittarii	EB	+1.08	+0.33	+0.14	−0.10	−0.17	+0.09	−0.15	+0.09	+0.77	+4.8	+1.2
12	Greenwich	π Arietis	IB	−1.15	−0.83	+0.03	+0.02	+0.04	−0.16	+0.22	+0.10	+0.71	−5.7	−1.7
12	Evanston	44 Arietis	E	+1.07	+0.75	−0.23	−0.09	−0.25	+0.12	−0.21	−0.26	−0.74	+6.1	+2.5
13	Greenwich	13 Tauri	IB	−1.05	−0.63	−0.37	−0.06	−0.38	−0.18	+0.13	−0.24	−0.85	−2.6	+1.1
13	Greenwich	14 Tauri	IB	−1.13	−0.68	+0.03	0.00	+0.03	−0.14	+0.14	+0.07	−0.90	−5.5	−1.5
28	Cape	λ Libræ	I	−0.80	+0.49	+0.51	+0.05	−0.51	+0.06	−0.11	+0.50	−0.72	−0.4	+2.4
Oct. 3	Greenwich	27 G. Capricor.	I	−1.08	−0.62	+0.09	−0.16	−0.18	−0.18	+0.26	+0.18	−0.84	−2.1	+1.7
Nov. 13	Cape	h Leonis	E	+0.36	−0.26	+0.19	−0.90	+0.92	−0.30	+0.18	+0.53	−0.39	+3.0	+1.8
26	Cape	g Sagittarii	I	−0.97	−0.27	+0.16	−0.23	−0.28	−0.14	+0.22	+0.51	−0.81	+1.1	+4.6
Dec. 5	Cape	67 Tauri	I	−0.89	+0.47	−0.59	+0.05	0.59	−0.18	+0.06	−0.48	−0.15	−3.6	−0.3
9	Cape	23 H[1]. Cancri	E	+0.93	−0.31	+0.17	−0.29	+0.34	−0.03	+0.26	+0.22	−0.58	+2.2	−1.0
1901, Jan. 28	Cape	22 H[1]. Tauri	I	−0.88	−0.65	−0.55	−0.01	−0.55	−0.17	+0.11	−0.37	−0.81	−3.2	+0.1
30	Pola	ζ Tauri	I	−0.21	−0.10	−0.03	−0.98	−0.98	0.00	−0.01	−0.96	−0.15	−1.1	−0.3
30	Pola	ζ Tauri	EB	+0.28	+0.14	−0.04	−0.96	−0.96	+0.06	+0.01	−0.93	+0.22	−0.7	−1.2
Feb. 15	Cape	ρ Sagittarii	E	+1.02	−0.04	+0.08	−0.09	−0.12	+0.07	−0.18	+0.05	−0.52	+4.7	+1.1
21	Pola	51 Piscium	I	−1.00	−0.88	−0.43	+0.15	+0.46	−0.02	+0.32	+0.13	−0.56	−3.3	+0.4
25	Cape	247 B. Tauri	I	−0.96	−0.63	−0.39	+0.07	−0.40	−0.13	+0.06	−0.29	−0.92	−4.1	−0.5
26	Cape	o Tauri	I	−0.88	−0.43	−0.46	+0.21	−0.51	−0.07	−0.01	−0.49	−0.84	−3.7	−0.4
Mar. 10	Cape	28 Libræ	E	+0.84	−0.81	+0.38	+0.04	−0.38	+0.04	+0.16	+0.22	−0.85	+5.2	+2.2
25	Cape	105 Tauri	I	−0.98	−0.56	−0.36	+0.14	−0.38	−0.12	+0.02	−0.30	−0.86	−3.6	+0.1
26	Greenwich	68 Orionis	I	−0.94	−0.41	−0.41	+0.30	−0.51	−0.04	−0.07	−0.45	−0.85	−3.6	0.0
28	Cape	5 Cancri	I	−0.76	+0.05	−0.29	+0.56	−0.63	+0.11	−0.20	−0.51	−0.75	−3.0	−0.1
Apr. 4	Cape	α Virginis	IB	−0.84	+0.93	−0.30	−0.19	+0.35	−0.07	−0.26	−0.08	+0.15	−3.0	+0.2
4	Cape	α Virginis	E	+0.89	−0.99	−0.13	−0.08	+0.15	−0.08	+0.31	−0.11	−0.16	+3.1	−0.1
7	Cape	56 B. Scorpii	E	+0.90	−0.79	−0.11	+0.02	+0.11	−0.04	+0.11	−0.17	−0.75	+3.3	+0.1
7	Cape	β Scorpii	E	+0.90	−0.79	−0.13	+0.02	+0.13	−0.04	+0.09	−0.17	−0.75	+2.9	−0.4
10	Cape	89 G. Sagittarii	E	+0.62	−0.19	−0.55	+0.53	+0.76	+0.11	−0.08	−0.82	−0.65	+1.2	−1.0
22	Greenwich	B. D. +19° 1110	I	−1.01	−0.53	−0.39	+0.25	−0.46	−0.10	−0.04	−0.44	−0.69	−3.0	+0.8
22	Greenwich	57 Orionis	I	−1.07	−0.56	−0.31	+0.21	−0.37	−0.12	−0.05	−0.34	−0.73	−3.6	+0.5
24	Cape	f Gem	I	−0.83	−0.07	−0.29	+0.48	−0.56	+0.05	−0.18	−0.46	−0.78	−2.9	+0.3
28	Greenwich	p^3 Leonis	I	−0.97	+0.67	+0.09	+0.21	−0.23	+0.10	−0.35	+0.01	−0.80	−3.5	+0.2
May 5	Cape	123 B. Scorpii	E	+0.89	−0.71	−0.26	+0.08	+0.28	−0.02	+0.05	−0.33	−0.40	+3.7	+0.5
31	Greenwich	11 H. Libræ	I	−0.56	+0.53	+0.81	−0.04	−0.81	+0.14	−0.10	+0.70	−0.13	−1.0	+1.1
June 4	Greenwich	171 B. Sagittarii	E	+0.65	−0.15	+0.47	−0.61	−0.77	−0.10	−0.10	+0.71	−0.38	+3.3	+0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1901, June 5	Cape	g Sagittarii	E	+0.98	−0.08	+0.02	−0.04	−0.05	+0.04	−0.19	−0.04	−0.76	+4.8	+1.2
12	Cape	19 Arietis	E	+0.81	+0.72	+0.66	+0.20	+0.69	+0.31	−0.17	+0.35	−0.51	+3.6	+0.6
22	Cape	p^5 Leonis	I	−0.31	+0.23	−0.44	−0.83	+0.94	−0.33	−0.06	+0.23	−0.31	−0.5	+0.7
25	Cape	α Virginis	I	−0.88	+0.86	−0.40	−0.22	+0.46	−0.11	−0.25	−0.14	−0.85	−2.8	+0.3
25	Cape	α Virginis	EB	+0.89	−0.96	−0.16	−0.09	+0.18	−0.09	+0.30	−0.11	+0.94	+2.1	−1.2
29	Greenwich	74 B. Ophiuchi	I	−1.01	+0.74	−0.07	+0.03	+0.08	−0.02	−0.04	+0.01	−0.35	−5.0	−1.1
July 10	Cape	ρ Arietis	E	+1.07	+0.97	−0.18	−0.01	−0.18	+0.12	−0.21	−0.20	−0.86	+2.6	−1.4
25	Pola	κ Libræ	I	−0.14	+0.15	−0.26	+0.95	−0.99	+0.14	−0.03	+0.80	−0.14	0.0	+0.5
28	Greenwich	21 Sagittarii	I	−0.93	+0.42	+0.29	−0.29	−0.41	−0.06	+0.08	+0.47	−0.45	−3.5	+0.1
Aug. 9	Cape	ζ Tauri	E	+1.03	+0.71	−0.20	+0.14	−0.24	+0.12	+0,02	−0.31	−0.82	+3.3	−0.5
19	Cape	86 Virginis	I	−0.85	+0.91	+0.33	+0.12	−0.35	+0.13	−0.28	+0.22	−0.81	−2.8	+0.5
22	Cape	ν Scorpii	I	−0.91	+0.92	+0.02	−0.01	−0.02	+0.03	−0.07	+0.08	−0.99	−4.5	−1.0
24	Greenwich	24 B. Sagittarii	I	−0.75	+0.44	+0.49	−0.44	−0.66	−0.04	+0.04	+0.71	−0.63	−4.2	−1.3
30	Cape	κ Piscium	E	+0.99	+0.57	+0.24	+0.36	+0.43	+0.29	−0.27	−0.12	−0.23	+4.3	+0.6
Sept. 25	Cape	30 Aquarii	I	−0.76	−0.17	+0.15	+0.68	+0.70	+0.14	+0.27	−0.31	−0.35	−3.0	0.0
Oct. 17	Wilhelmshaven	ξ Ophiuchi	I	−0.41	+0.38	−0.73	+0.52	+0.89	+0.03	−0.01	−0.84	−0.39	−3.3	−1.7
19	Evanston	ρ Sagittarii	I	−0.85	+0.31	+0.20	−0.40	−0.45	−0.08	+0.14	+0.48	−0.90	−2.4	+1.0
21	Cape	16 B. Aquarii	I	−0.82	+0.82	−0.03	+0.56	+0.56	+0.11	+0.25	−0.36	−0.80	−3.5	−0.1
23	Greenwich	κ Aquarii	I	−1.06	−0.48	−0.07	−0.15	−0.16	−0.18	+0.32	+0.11	−0.70	−5.1	−0.9
24	Evanston	λ Piscium	I	−0.68	−0.44	−0.48	−0.62	−0.78	−0.36	+0.17	+0.11	−0.32	−3.3	−0.6
27	Greenwich	29 Arietis	IB	−0.84	−0.68	−0.72	−0.06	−0.72	−0.32	+0.13	−0.42	+0.03	−4.8	−1.5
27	Greenwich	29 Arietis	E	+0.95	+0.77	−0.61	−0.04	−0.62	+0.04	−0.19	−0.44	−0.04	+1.8	−1.8
29	Cape	129 H^1. Tauri	E	+1.08	+0.88	−0.29	+0.14	−0.33	+0.17	−0.07	−0.36	−0.44	+6.5	+2.4
Nov. 16	Cape	283 B. Sagittarii	I	−0.53	+0.25	+0.26	−0.78	−0.82	−0.15	+0.10	+0.80	−0.51	−0.4	+1.7
Dec. 18	Greenwich	λ Piscium	I	−0.53	−0.33	−0.60	−0.61	−0.86	−0.33	+0.12	+0.10	−0.51	−1.0	+1.1
18	Greenwich	λ Piscium	EB	+0.70	+0.43	−0.52	−0.52	−0.73	−0.19	−0.27	+0.05	+0.67	+1.9	−0.8
18	Cape	19 Piscium	I	−1.01	+0.53	−0.17	−0.16	−0.23	−0.17	+0.32	+0.09	−0.96	−1.6	+2.5
19	Evanston	62 Piscium	I	−0.94	−0.74	+0.42	+0.24	+0.48	+0.03	+0.31	+0.16	−0.83	−1.7	+2.1
21	Evanston	o Arietis	I	−0.86	−0.76	+0.64	−0.01	+0.64	0.00	+0.19	+0.47	−0.52	−2.0	+1.6
22	Cape	175 B. Arietis	I	−0.97	−0.86	−0.50	+0.10	−0.51	−0.25	+0.14	−0.34	−0.52	−1.9	+2.1
1902, Jan. 18	Cape	53 Arietis	I	−0.79	−0.72	−0.67	+0.10	−0.68	−0.23	+0.13	−0.45	−0.67	−2.0	+1.2
19	Cape	43 Tauri	I	−0.40	−0.36	+0.86	−0.37	+0.93	+0.04	+0.04	+0.86	−0.29	−2.7	−1.1
31	Cape	ν Libræ	E	+0.90	−0.97	+0.12	−0.02	−0.12	−0.01	+0.19	+0.04	−0.98	+6.9	+3.4
Feb. 12	Wilhelmshaven	ε Piscium	I	−0.78	−0.56	+0.63	+0.25	+0.67	−0.05	+0.26	+0.21	−0.62	−1.4	+1.8
12	Greenwich	ε Piscium	I	−0.67	−0.47	+0.73	+0.28	+0.78	+0.16	+0.23	+0.24	−0.53	−3.4	−0.7
12	Greenwich	ε Piscium	EB	+0.50	+0.35	+0.75	+0.45	+0.88	+0.16	−0.06	+0.20	+0.39	+1.0	−1.0
13	Greenwich	26 B. Arietis	I	−1.07	−0.89	−0.21	−0.03	−0.21	−0.17	+0.25	−0.06	−0.93	−4.5	−0.1
14	Wilhelmshaven	σ Arietis	I	−0.84	−0.76	+0.62	−0.06	+0.62	−0.07	+0.18	+0.45	−0.78	−3.1	+0.3
15	Greenwich	163 B. Tauri	I	−0.57	−0.51	−0.79	+0.34	−0.86	−0.17	+0.05	−0.72	−0.50	−2.1	+0.2
16	Greenwich	i Tauri	I	−0.85	−0.74	+0.55	−0.37	+0.66	−0.07	+0.04	+0.68	−0.72	−2.0	+1.5
16	Wilhelmshaven	i Tauri	I	−0.87	−0.79	+0.49	−0.33	+0.59	−0.10	+0.04	+0.59	−0.78	−4.8	−1.2
17	Cape	χ^1 Orionis	I	−1.06	−0.88	+0.11	−0.13	+0.17	−0.14	−0.04	+0.22	−0.87	−4.1	+0.3
Mar. 17	Greenwich	26 Geminor.	I	−0.86	−0.64	+0.29	−0.57	+0.64	−0.16	−0.07	+0.67	−0.74	−4.4	−0.9
20	Greenwich	ω Leo. (1st)	I	−1.03	−0.31	+0.03	+0.01	−0.02	−0.07	−0.28	+0.05	−0.65	−4.2	0.0
20	Greenwich	ω Leo. (2d)	I	−1.03	−0.31	0.00	+0.01	−0.02	−0.07	−0.28	+0.05	−0.65	−4.1	+0.1
20	Cape	h Leonis	I	−0.95	+0.21	−0.09	−0.35	+0.36	−0.17	−0.26	+0.15	−0.60	−3.9	0.0
25	Cape	h Virginis	E	+0.90	−0.72	−0.29	−0.06	+0.30	−0.08	+0.29	0.00	−0.29	+4.5	+0.9
28	Cape	73 B. Scorpii	E	+0.87	−0.96	−0.24	+0.12	+0.27	−0.07	+0.11	−0.30	−0.82	+3.7	+0.2
29	Cape	29 Ophiuchi	E	+0.34	−0.37	+0.72	−0.59	−0.93	+0.02	+0.01	+0.87	−0.35	+3.1	+1.8
Apr. 21	Wilhelmshaven	α Virginis	I	−0.80	+0.57	−0.50	−0.11	+0.51	+0.04	−0.22	−0.14	−0.15	−4.3	−0.9
May 10	Cape	57 Orionis	I	−0.93	−0.78	+0.33	−0.46	+0.57	−0.17	−0.03	+0.62	−0.49	−5.8	−1.9
11	Berlin	41 H^1. Geminor.	I	−0.17	−0.13	+0.33	−0.93	+0.99	−0.15	−0.01	+0.96	−0.13	−0.2	+0.9
11	Berlin	B. D. +16° 1373	I	−1.02	−0.81	+0.16	−0.38	+0.40	−0.19	−0.10	+0.42	−0.83	−4.0	+0.3
11	Berlin	B. D. +17° 1488	I	−0.81	−0.63	−0.19	+0.63	−0.67	−0.03	−0.09	−0.64	−0.65	−3.6	−0.2
11	Berlin	B. D. +16° 1380	I	−1.05	−0.83	+0.13	−0.29	+0.30	−0.18	−0.10	+0.33	−0.86	−4.6	−0.1
11	Berlin	B. D. +16° 1385	I	−1.07	−0.85	+0.11	−0.23	+0.24	−0.18	−0.10	+0.25	−0.88	−4.6	0.0
12	Cape	1 Cancri	I	−0.35	−0.22	+0.10	−0.94	+0.94	−0.22	−0.05	+0.87	−0.29	−1.4	0.0
12	Greenwich	12 Cancri	I	−0.21	−0.15	+0.05	−0.98	+0.98	−0.23	−0.02	+0.84	−0.17	−2.2	−1.3
14	Berlin	B. D. + 7° 2203	I	−0.63	−0.22	+0.35	+0.75	−0.83	+0.18	−0.25	−0.41	−0.71	−3.2	−0.5
15	Berlin	36 Sextantis	I	−0.98	−0.13	+0.18	+0.21	−0.27	+0.01	−0.38	−0.03	−1.11	−3.6	+0.6
17	Berlin	B. D. − 5° 3487	I	−0.95	+0.33	+0.16	+0.09	−0.20	+0.03	−0.39	+0.07	−0.93	−4.0	+0.1
18	Berlin	B. D. − 9° 3640	I	−0.81	+0.46	−0.43	−0.11	+0.44	−0.14	−0.32	−0.12	−0.68	−4.6	−1.1
19	Berlin	B. D. −12° 3933	I	−0.92	+0.72	+0.05	0.00	−0.10	+0.02	−0.36	+0.05	−0.61	−4.1	−0.1
25	Berlin	B. D. −18° 5155	E	+0.68	−0.61	+0.19	−0.60	−0.64	−0.10	+0.07	+0.60	−0.46	+3.0	+0.3
June 10	Cape	η Leonis	I	−0.90	+0.32	−0.17	−0.49	+0.52	−0.24	−0.23	+0.23	−0.71	−4.4	−0.5
15	Berlin	86 Virginis	I	−0.93	+0.61	+0.04	+0.01	−0.08	+0.01	−0.36	+0.04	−0.93	−4.1	−0.1
17	Cape	32 Libræ	I	−0.85	+0.88	+0.32	−0.13	−0.35	+0.09	−0.16	+0.32	−0.55	−2.8	+0.9
18	Berlin	B. D. −19° 4332	I	−0.88	+0.95	−0.14	+0.07	+0.15	+0.02	−0.19	−0.15	−0.43	−4.2	−0.4
18	Berlin	ν Scorpii	I	−0.87	+0.94	−0.17	+0.10	+0.18	+0.02	−0.19	−0.18	−0.42	−5.1	−1.4
18	Wilhelmshaven	ν Scorpii	I	−0.87	+0.94	−0.23	+0.14	+0.26	+0.05	−0.11	−0.18	−0.42	−4.8	−1.1

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													''	''
1902, June 18	Greenwich	ν Scorpii	I	−0.87	+0.90	−0.32	+0.19	+0.38	+0.01	−0.10	−0.27	−0.40	−3.3	+0.4
23	Berlin	B.D. −15° 5663	E	+0.83	−0.52	−0.02	+0.45	+0.45	+0.09	−0.20	−0.43	−0.58	+3.9	+0.6
25	Berlin	B.D. − 8° 5791	E	+0.74	−0.13	−0.34	−0.62	−0.70	−0.18	−0.30	+0.30	−0.76	+3.2	+0.2
27	Berlin	B.D. − 0° 4547	E	+0.99	+0.27	−0.23	−0.18	−0.30	0.00	−0.41	−0.03	−1.17	+4.3	+0.3
28	Berlin	116 B. Piscium	E	+0.31	+0.14	−0.88	−0.39	−0.97	−0.27	−0.16	−0.13	−0.36	+0.5	−0.8
28	Berlin	B.D.+ 3° 56	E	+1.04	+0.48	−0.11	−0.06	−0.15	+0.08	−0.40	−0.06	−1.21	+3.9	−0.3
28	Berlin	B.D.+ 4° 66	E	+1.00	+0.46	−0.31	−0.14	−0.37	+0.01	−0.40	−0.09	−1.16	+2.8	−1.2
28	Berlin	B.D.+ 4° 73	E	+1.04	+0.49	−0.02	−0.02	−0.05	+0.12	−0.39	−0.04	−1.21	+3.4	−0.8
July 11	Cape	261 B. Virginis	I	−0.84	+0.35	−0.46	−0.17	+0.49	−0.17	−0.25	−0.04	−0.84	−4.1	−0.5
11	Cape	f Virginis	I	−0.83	+0.34	−0.47	−0.18	+0.50	−0.17	−0.25	−0.04	−0.83	−3.4	+0.2
15	Berlin	B.D. −18° 4196	I	−0.90	+0.93	+0.80	−0.06	−0.11	+0.05	−0.21	+0.09	−0.78	−4.7	−0.8
18	Cape	100 B. Sagittarii	I	−0.90	+0.94	−0.04	+0.10	+0.10	+0.05	+0.08	−0.05	−0.31	−5.5	−1.6
19	Wilhelmshaven	ρ Sagittarii	I	−0.59	+0.54	+0.16	−0.75	−0.76	−0.09	+0.10	+0.79	−0.07	−5.6	−3.1
19	Berlin	ρ Sagittarii	I	−0.66	+0.60	+0.14	−0.68	−0.70	+0.02	+0.10	+0.69	−0.07	−1.5	+1.3
21	Berlin	8 Aquarii	E	+0.60	+0.32	+0.17	+0.76	+0.77	−0.28	+0.13	−0.60	+0.20	−0.3	−2.7
21	Berlin	B.D. −13° 5830	E	+0.76	−0.40	−0.18	−0.60	−0.62	−0.15	−0.26	+0.39	−0.36	+3.5	+0.4
22	Berlin	B.D. − 9° 5854	E	+0.82	−0.25	−0.27	−0.52	−0.57	−0.14	−0.31	+0.27	−0.56	+4.4	+1.1
28	Berlin	B.D.+14° 502	E	+0.42	+0.33	−0.91	+0.27	−0.96	−0.12	−0.12	−0.67	−0.48	+2.3	+0.6
Oct. 10	Berlin	B.D. −16° 5478	I	−0.73	+0.66	+0.02	−0.59	−0.60	−0.08	+0.14	+0.56	−0.60	−3.9	−0.7
11	Berlin	87 B. Capricor.	I	−0.84	+0.61	+0.15	+0.42	+0.44	+0.12	+0.26	−0.27	−0.61	−6.1	−2.5
16	Greenwich	ζ Piscium	I	−0.97	−0.39	+0.45	+0.05	+0.45	+0.02	+0.28	+0.17	−0.02	−3.7	+0.5
19	Berlin	B.D.+16° 561	E	+0.82	+0.67	−0.56	+0.43	−0.71	+0.04	−0.15	−0.62	−0.60	+2.6	−0.8
19	Berlin	B.D.+16° 568	E	+1.10	+0.91	−0.08	+0.07	−0.12	+0.15	−0.19	−0.07	−0.74	+5.0	+0.5
19	Berlin	193 B. Tauri	E	+1.10	+0.91	−0.07	+0.06	−0.09	+0.16	−0.19	−0.06	−0.75	+5.9	+1.4
21	Berlin	B.D.+17° 1135	E	+1.09	+0.97	+0.05	−0.18	+0.20	+0.16	0.00	+0.20	−1.04	+3.9	−0.6
21	Berlin	B.D.+17° 1144	E	+1.04	+0.93	+0.11	−0.30	+0.34	+0.14	+0.01	+0.34	−1.00	+4.2	−0.1
21	Berlin	B.D.+18° 1112	E	+0.80	+0.71	−0.32	+0.66	−0.75	+0.15	0.00	−0.72	−0.77	+3.8	+0.5
21	Berlin	B.D.+17° 1158	E	+0.85	+0.76	+0.23	−0.57	+0.62	+0.10	0.00	+0.63	−0.82	+4.5	+1.0
21	Berlin	B.D.+17° 1161	E	+0.82	+0.73	+0.24	−0.61	+0.66	+0.09	+0.01	+0.66	−0.79	+4.1	+0.7
21	Berlin	124 H.[1] Orionis	E	+1.10	+0.99	+0.02	−0.13	−0.14	+0.16	+0.01	+0.14	−1.07	+4.7	+0.2
21	Berlin	B.D.+18° 1147	E	+0.71	+0.64	−0.33	+0.73	−0.80	+0.15	+0.01	−0.80	−0.69	+3.6	+0.7
21	Berlin	B.D.+18° 1178	E	+0.90	+0.81	−0.25	+0.57	−0.62	+0.17	+0.02	−0.63	−0.90	+4.8	+1.1
21	Berlin	B.D.+18° 1179	E	+0.92	+0.83	−0.24	+0.55	−0.59	+0.17	+0.02	−0.60	−0.91	+4.3	+0.5
22	Berlin	λ Geminor	IB	−0.87	−0.82	−0.08	+0.58	−0.59	−0.05	−0.06	−0.47	+0.82	−4.6	−0.9
22	Berlin	λ Geminor.	E	+0.90	+0.78	−0.07	+0.54	−0.55	+0.13	+0.06	−0.62	−0.77	+3.1	−0.6
22	Berlin	B.D.+16° 1419	E	+1.06	+0.92	−0.09	+0.31	−0.31	+0.20	+0.11	−0.33	−1.09	+5.0	+0.6
22	Berlin	B.D.+16° 1421	E	+1.09	+0.95	−0.07	+0.21	−0.21	+0.19	+0.12	−0.23	−1.12	+5.8	+1.3
22	Berlin	B.D.+16° 1423	E	+0.99	+0.86	−0.11	+0.46	−0.46	+0.21	+0.10	−0.46	−1.02	+4.3	+0.2
22	Berlin	B.D.+16° 1426	E	+0.73	+0.64	−0.14	+0.75	−0.76	+0.21	+0.07	−0.74	−0.75	+3.4	+0.4
22	Berlin	B.D.+16° 1436	E	+0.98	+0.85	+0.03	−0.46	+0.46	+0.09	+0.07	+0.42	−1.01	+4.8	+0.8
22	Berlin	B.D.+16° 1441	E	+1.02	+0.88	−0.09	+0.41	−0.42	+0.20	+0.11	−0.42	−1.05	+4.8	+0.6
22	Berlin	B.D.+16° 1448	E	+0.85	+0.74	+0.04	−0.63	+0.63	+0.04	+0.11	+0.58	−0.88	+4.9	+1.4
22	Cobham	λ Geminor.	E	+0.91	+0.81	−0.07	+0.55	−0.55	+0.20	+0.11	−0.56	−0.80	+2.9	−0.9
23	Berlin	B.D.+14° 1850	E	+1.10	+0.88	−0.04	+0.05	−0.05	+0.17	+0.21	−0.09	−1.14	+5.2	+0.7
23	Berlin	B.D.+14° 1854	E	+1.09	+0.88	−0.05	−0.12	+0.12	+0.13	+0.21	+0.04	−1.14	+4.8	+0.3
24	Berlin	κ Cancri	E	+1.04	+0.74	−0.03	−0.07	+0.08	+0.08	+0.24	+0.02	−0.98	+4.2	−0.1
24	Berlin	B.D.+10° 1956	E	+1.07	+0.73	−0.08	−0.13	+0.14	+0.11	+0.30	+0.02	−1.08	+4.2	−0.2
Nov. 6	Cape	283 B. Sagittarii	I	−0.81	+0.82	0.00	−0.44	−0.44	−0.03	+0.15	+0.45	−0.85	−3.3	+0.2
8	Berlin	B.D. −11° 5578	I	−0.85	+0.55	+0.21	+0.42	+0.46	+0.12	+0.29	−0.24	−0.69	−4.5	−0.8
8	Berlin	B.D. −11° 5583	I	−0.41	+0.26	+0.40	+0.84	+0.92	+0.24	+0.17	−0.59	−0.34	−1.1	+0.7
8	Berlin	B.D. −11° 5589	I	−0.86	+0.54	+0.21	+0.39	+0.44	+0.12	+0.31	−0.22	−0.70	−5.2	−1.4
11	Berlin	B.D. − 0° 4566	I	−0.94	−0.03	−0.25	−0.12	−0.26	−0.15	+0.36	+0.08	−0.52	−5.4	−1.3
11	Berlin	21 Piscium	I	−0.11	−0.01	−0.88	−0.44	−0.98	−0.32	0.00	+0.07	−0.06	−2.1	−1.6
14	Berlin	B.D.+12° 354	I	−1.03	−0.64	−0.18	+0.04	−0.18	−0.18	+0.30	−0.14	−0.02	−6.4	−1.9
14	Berlin	B.D.+12° 370	I	−1.06	−0.68	−0.08	+0.02	−0.08	−0.16	+0.31	−0.05	+0.01	−6.5	−1.8
17	Cape	57 Orionis	E	+1.00	+0.88	−0.20	+0.42	−0.46	+0.17	+0.03	−0.50	−0.43	+4.2	0.0
17	Berlin	B.D.+18° 990	E	+0.89	+0.80	−0.31	+0.57	−0.64	+0.16	−0.02	−0.63	−0.51	+4.7	+1.0
17	Berlin	B.D.+18° 1001	E	+1.05	+0.94	+0.11	−0.28	+0.31	+0.15	−0.02	+0.31	−0.61	+3.1	−1.3
17	Berlin	B.D.+18° 1012	E	+0.67	+0.59	−0.38	+0.75	−0.83	+0.12	−0.02	−0.83	−0.39	+3.7	+0.9
18	Berlin	B.D.+17° 1392	E	+0.90	+0.80	+0.11	−0.56	+0.57	+0.09	+0.06	+0.56	−0.63	+4.8	+1.0
18	Berlin	41 H[1]. Geminor.	E	+0.62	+0.55	+0.11	−0.82	+0.83	0.00	+0.06	+0.80	−0.46	+2.9	+0.3
19	Berlin	B.D.+15° 1672	E	+1.10	+0.94	−0.05	−0.06	+0.06	+0.15	+0.18	0.00	−0.91	+3.6	−1.0
19	Berlin	B.D.+15° 1676	E	+0.49	+0.42	−0.04	−0.90	+0.90	−0.08	+0.09	+0.81	−0.40	+1.6	−0.4
20	Berlin	B.D.+12° 1927	E	+1.06	+0.82	+0.03	+0.21	−0.23	+0.20	+0.25	−0.23	−0.97	+4.6	+0.2
20	Berlin	60 Cancri	E	+1.08	+0.82	+0.01	+0.15	−0.16	+0.19	+0.26	−0.18	−0.99	+4.2	−0.3
20	Cobham	60 Cancri	E	+1.06	+0.82	+0.04	+0.11	−0.12	+0.15	+0.24	−0.14	−0.90	+4.5	+0.1
22	Berlin	34 Sextantis	E	+1.05	+0.50	−0.06	−0.06	+0.09	+0.10	+0.38	−0.02	−1.00	+4.1	−0.3
22	Berlin	B.D.+ 3° 2406	E	+0.59	+0.27	−0.62	−0.60	+0.87	−0.20	+0.25	+0.28	−0.55	+2.5	0.0
22	Berlin	B.D.+ 4° 2378	E	+1.03	+0.48	−0.19	−0.18	+0.27	+0.04	+0.39	+0.03	−0.97	+4.0	−0.3
22	Berlin	B.D.+ 3° 2411	E	+1.01	+0.46	−0.24	−0.22	+0.33	+0.02	+0.38	+0.05	−0.96	+4.1	−0.1

GROUP XIII—1891-1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1902, Dec.	4	Greenwich	β Capricor.	I	−0.71	+0.62	−0.12	−0.64	−0.65	−0.10	+0.14	+0.57	−0.63	−2.7	+0.4
	11	Berlin	34 B. Arietis	I	−1.04	−0.54	−0.13	+0.02	−0.13	−0.16	+0.34	−0.07	−0.56	−6.3	−1.7
	11	Berlin	B. D. +10° 292	I	−0.44	−0.24	+0.92	−0.16	+0.95	+0.18	+0.17	+0.50	−0.23	−0.7	+1.2
	11	Berlin	B. D. +11° 295	I	−1.06	−0.59	−0.02	0.00	+0.02	−0.14	+0.34	−0.01	−0.53	−6.2	−1.5
	12	Berlin	B. D. +13° 494	I	−1.07	−0.73	+0.11	−0.06	+0.16	−0.12	+0.29	+0.08	−0.41	−5.2	−0.5
	13	Berlin	δ Tauri	I	−1.14	−0.88	−0.08	+0.08	−0.11	−0.20	+0.11	−0.08	−0.27	−5.8	−0.8
	13	Berlin	64 Tauri	I	−1.11	−0.89	+0.19	−0.18	+0.27	−0.19	+0.10	+0.27	−0.26	−2.7	+2.2
	13	Berlin	180 B. Tauri	I	−0.33	−0.27	−0.72	+0.58	−0.93	−0.16	+0.05	−0.82	−0.06	−1.9	−0.4
	13	Berlin	B. D. +16° 561	I	−0.81	−0.65	−0.48	+0.39	−0.62	−0.19	+0.15	−0.58	−0.15	−4.4	−0.9
	13	Berlin	193 B. Tauri	I	−1.10	−0.88	+0.01	−0.02	+0.02	−0.16	+0.19	0.00	−0.19	−7.5	−2.7
1903, Jan.	6	Berlin	171 B. Piscium	I	−0.97	−0.26	−0.24	−0.02	−0.24	−0.16	+0.35	−0.04	−0.86	−3.8	+0.5
	9	Berlin	B. D. +15° 531	I	−1.07	−0.81	−0.11	+0.07	−0.12	−0.17	+0.23	−0.13	−0.70	−5.8	−1.1
	12	Berlin	B. D. +17° 1409	I	−0.82	−0.73	−0.10	+0.66	−0.67	−0.06	−0.06	−0.65	−0.17	−5.0	−1.4
	14	Cobham	α Cancri	E	+1.06	+0.80	+0.13	+0.34	−0.37	+0.27	+0.21	−0.33	−0.24	+6.7	+2.2
	15	Berlin	B. D. + 7° 2227	E	+1.08	+0.71	−0.09	−0.10	+0.13	+0.12	+0.34	0.00	−0.41	+5.0	+0.5
	15	Berlin	B. D. + 7° 2232	E	+0.93	+0.61	+0.28	+0.36	−0.46	+0.26	+0.29	−0.29	−0.36	+5.0	+1.1
	18	Berlin	B. D. − 6° 3656	E	+1.00	+0.06	0.00	−0.01	+0.04	+0.07	+0.39	−0.02	−0.76	+4.6	+0.4
	19	Berlin	h Virginis	E	+0.69	−0.09	−0.75	+0.04	+0.77	−0.18	+0.29	−0.31	−0.56	+3.6	+0.7
	19	Berlin	B. D. − 9° 3736	E	+0.66	−0.11	+0.70	−0.06	−0.70	+0.23	+0.22	+0.30	−0.53	+4.0	+1.2
	20	Berlin	6 G. Libræ	E	+0.75	−0.28	+0.55	−0.16	−0.55	+0.15	+0.24	+0.34	−0.62	+3.2	0.0
Feb.	2	Berlin	B. D. + 3° 86	I	−0.93	−0.11	+0.43	+0.08	+0.47	+0.07	+0.38	+0.11	−0.75	−4.5	−0.4
	6	Berlin	64 Tauri	I	−0.53	−0.43	−0.59	+0.64	−0.87	−0.06	+0.05	−0.78	−0.45	−3.0	−0.7
	6	Berlin	B. D. +16° 577	I	−1.00	−0.79	+0.33	−0.33	+0.47	−0.09	+0.17	−0.41	−0.91	−4.4	0.0
	6	Berlin	B. D. +16° 582	I	−1.07	−0.84	+0.21	−0.21	+0.30	−0.12	+0.18	+0.26	−0.96	−2.1	+2.6
	6	Berlin	B. D. +16° 591	I	−0.95	−0.76	+0.38	−0.40	+0.55	−0.08	+0.15	+0.49	−0.85	−5.2	−1.0
	6	Berlin	B. D. +17° 722	I	−0.64	−0.51	−0.52	+0.57	−0.78	−0.18	+0.09	−0.73	−0.57	−2.9	−0.1
	6	Berlin	B. D. +16° 600	I	−1.05	−0.84	+0.25	−0.27	+0.36	−0.11	+0.16	+0.31	−0.94	−2.2	+2.4
	6	Berlin	B. D. +16° 602	I	−0.72	−0.58	+0.54	−0.58	+0.79	−0.02	+0.11	+0.71	−0.64	−2.8	+0.4
	6	Berlin	B. D. +16° 606	I	−1.09	−0.88	−0.04	+0.05	−0.06	−0.17	+0.16	−0.08	−0.97	−5.6	−0.8
	7	Berlin	B. D. +18° 825	I	−1.03	−0.90	−0.14	+0.27	−0.32	−0.17	+0.08	−0.32	−0.85	−4.8	−0.3
	7	Berlin	115 Tauri	I	−1.01	−0.87	+0.24	−0.40	+0.45	−0.14	+0.06	+0.44	−0.81	−4.2	+0.3
	7	Cape	352 B. Tauri	I	−1.01	−0.85	−0.20	+0.35	−0.41	−0.16	+0.03	−0.37	−0.74	−4.4	+0.1
	9	Berlin	68 Geminor.	I	−1.10	−0.95	−0.01	−0.26	+0.26	−0.17	−0.15	+0.26	−0.46	−5.1	−0.2
	9	Berlin	B. D. +16° 1506	I	−1.10	−0.97	+0.05	+0.19	−0.19	−0.14	−0.16	−0.15	−0.58	−5.7	−0.8
	9	Berlin	67 Geminor.	I	−0.48	−0.43	−0.01	−0.90	+0.90	−0.19	+0.06	−0.87	−0.25	−4.0	−1.9
	9	Berlin	B. D. +15° 1605	I	−0.88	−0.77	+0.01	−0.61	+0.61	−0.21	−0.12	+0.60	−0.46	−5.8	−1.9
	9	Berlin	B. D. +16° 1518	I	−1.12	−0.98	+0.04	−0.05	+0.05	−0.17	−0.16	+0.09	−0.58	−6.5	−1.6
	12	Berlin	155 B. Leonis	E	+1.06	+0.66	−0.14	−0.14	+0.20	+0.08	+0.37	+0.03	+0.02	+5.4	+0.9
	15	Berlin	487 B. Virginis	E	+0.94	−0.03	+0.27	−0.01	+0.27	+0.14	+0.35	+0.08	−0.51	+5.7	+1.7
	16	Berlin	B. D. −11° 3659	E	+0.66	−0.15	−0.74	+0.17	+0.79	−0.17	+0.27	−0.41	−0.43	+4.3	+1.5
	16	Berlin	B. D. −11° 3668	E	+0.88	−0.22	+0.36	−0.08	−0.37	+0.12	+0.31	+0.22	−0.58	+4.9	+1.1
	16	Berlin	B. D. −11° 3684	E	+0.96	−0.27	+0.04	−0.01	−0.04	+0.05	+0.35	+0.05	−0.65	+5.7	+1.6
	19	Cape	24 Scorpii	E	+0.91	−0.85	+0.01	−0.01	−0.01	−0.04	+0.10	−0.01	−0.99	+5.1	+1.2
Mar.	2	Berlin	B. D. + 6° 195	I	−1.02	−0.22	+0.02	0.00	+0.07	−0.08	+0.38	+0.01	−0.67	−3.9	+0.7
	4	Berlin	B. D. +13° 499	I	−0.88	−0.52	−0.45	+0.24	−0.49	−0.21	+0.23	−0.39	−0.82	−4.8	−0.9
	5	Cape	173 B. Tauri	I	−0.32	−0.23	+0.68	−0.66	+0.95	+0.10	+0.05	+0.83	−0.31	−2.5	−1.1
	6	Berlin	B. D. +17° 841	I	+1.06	−0.88	−0.10	+0.19	−0.23	−0.16	+0.10	−0.24	−1.08	−4.4	+0.4
	7	Berlin	B. D. +17° 1082	I	−1.02	−0.90	+0.17	−0.40	+0.43	−0.16	+0.02	+0.43	−1.04	−4.4	+0.2
	7	Berlin	B. D. +17° 1089	I	−1.11	−0.97	+0.07	−0.11	+0.12	−0.17	+0.02	+0.11	−1.12	−4.1	+0.9
	7	Berlin	B. D. +18° 1061	I	−0.98	−0.87	−0.11	+0.41	−0.44	−0.14	+0.01	−0.44	−1.00	−4.1	+0.3
	7	Berlin	B. D. +18° 1060	I	−0.82	−0.72	−0.18	+0.62	−0.66	−0.11	+0.01	−0.64	−0.83	−4.0	−0.3
	7	Berlin	B. D. +18° 1067	I	−1.00	−0.88	−0.10	+0.40	−0.42	−0.14	+0.01	−0.42	−1.00	−3.7	+0.8
	7	Berlin	B. D. +17° 1101	I	−0.69	−0.60	+0.27	−0.76	+0.80	−0.12	0.00	+0.81	−0.69	−3.7	−0.6
	7	Berlin	B. D. +17° 1113	I	−1.08	−0.95	+0.12	−0.25	+0.26	−0.17	0.00	+0.26	−1.09	−2.2	+2.6
	7	Berlin	B. D. +18° 1084	I	−0.40	−0.35	−0.26	+0.89	−0.93	−0.04	0.00	−0.93	−0.40	−1.0	+0.8
	7	Berlin	B. D. +17° 1135	I	−1.02	−0.90	−0.08	+0.37	−0.38	−0.14	−0.01	−0.38	−1.02	−3.5	+1.1
	7	Berlin	B. D. +17° 1144	I	−1.01	−0.89	−0.08	+0.39	−0.41	−0.14	−0.01	−0.41	−1.01	−3.7	+0.8
	7	Berlin	B. D. +17° 1147	I	−1.11	−0.98	+0.02	+0.04	−0.04	−0.17	−0.01	−0.04	−1.11	−4.9	+0.1
	7	Berlin	B. D. +17° 1151	I	−1.11	−0.98	+0.03	+0.01	−0.03	−0.17	−0.01	−0.01	−1.11	−5.4	−0.4
	7	Berlin	B. D. +17° 1158	I	−0.98	−0.87	−0.09	+0.44	−0.46	−0.13	−0.02	−0.46	−0.98	−3.9	+0.5
	7	Berlin	B. D. +17° 1154	I	−0.37	−0.33	+0.27	−0.91	+0.95	−0.09	−0.01	+0.95	−0.38	−2.5	−0.9
	8	Berlin	B. D. +17° 1469	I	−1.11	−0.99	+0.03	+0.14	−0.14	−0.15	−0.10	−0.11	−1.06	−4.5	+0.5
	8	Berlin	B. D. +17° 1477	I	−1.07	−0.95	+0.02	+0.30	−0.30	−0.13	−0.10	−0.27	−1.02	−4.2	+0.6
	8	Berlin	41 H′. Geminor.	I	−0.84	−0.75	+0.08	−0.67	+0.67	−0.19	−0.08	+0.66	−0.80	−5.7	−1.9
	8	Berlin	B. D. +16° 1373	I	−1.11	−0.99	+0.05	−0.12	+0.12	−0.18	−0.11	+0.14	−1.06	−4.0	+1.0
	8	Berlin	B. D. +16° 1380	I	−1.12	−1.00	+0.05	−0.05	+0.05	−0.17	−0.10	+0.07	−1.06	−5.4	−0.4
	8	Berlin	B. D. +17° 1488	I	−0.13	−0.12	−0.05	+1.00	−1.00	+0.08	−0.02	−0.97	−0.13	−1.0	−0.4
	8	Berlin	B. D. +16° 1385	I	−1.12	−1.00	+0.04	−0.02	+0.04	−0.17	−0.11	+0.06	−1.06	−5.6	−0.6
	8	Berlin	B. D. +16° 1395	I	−1.11	−1.00	+0.04	+0.10	−0.11	−0.16	−0.12	−0.07	−1.05	−5.4	−0.4
	8	Berlin	B. D. +16° 1398	I	−1.06	−0.95	+0.05	−0.31	+0.32	−0.19	−0.11	+0.33	−1.00	−3.1	+1.6

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1903, Mar. 8	Berlin	B. D.+16° 1400	I	−1.12	−0.99	+0.02	0.00	+0.02	−0.17	−0.12	+0.03	−1.06	−5.0	0.0
8	Berlin	51 Geminor.	I	−0.85	−0.77	+0.05	−0.64	+0.64	−0.20	−0.09	+0.64	−0.80	−5.8	−2.0
8	Berlin	B. D.+16° 1421	I	−0.37	−0.33	0.00	+0.95	−0.95	+0.05	−0.05	−0.90	−0.35	−0.9	+0.7
8	Cobham	51 Geminor.	I	−0.60	−0.55	+0.01	−0.84	+0.84	−0.18	−0.06	+0.82	−0.47	−3.1	−0.4
12	Berlin	B. D.+ 2° 2386	I	−1.04	−0.53	−0.08	−0.04	+0.08	−0.16	−0.38	+0.07	−0.34	−5.1	−0.4
12	Berlin	p Leonis	I	−1.03	−0.52	+0.25	+0.17	−0.32	−0.03	−0.39	−0.03	−0.34	−5.1	−0.5
17	Berlin	34 Libræ	E	+0.94	−0.55	0.00	0.00	0.00	0.00	+0.25	+0.03	−0.56	+5.0	+1.0
17	Berlin	ζ Libræ	E	+0.86	−0.55	−0.36	+0.28	+0.46	−0.08	+0.23	−0.34	−0.52	+4.8	+1.1
Apr. 4	Cape	74 B. Geminor.	I	−0.73	−0.68	+0.08	−0.73	+0.73	−0.15	−0.06	+0.75	−0.68	−2.4	+0.9
May 2	Greenwich	68 Geminor.	I	−1.11	−0.98	+0.02	+0.20	−0.20	−0.11	−0.14	−0.20	−0.94	−4.3	+0.7
June 2	Greenwich	p^4 Leonis	I	−0.91	−0.60	−0.08	−0.48	+0.48	−0.23	−0.25	+0.16	−0.88	−3.8	+0.3
2	Cobham	p^4 Leonis	I	−0.91	−0.59	−0.43	−0.23	+0.49	−0.23	−0.25	+0.16	−0.87	−4.3	+0.2
Aug. 1	Cape	η Libræ	I	−0.93	−0.44	+0.09	−0.09	−0.13	+0.03	+0.09	−0.07	−0.97	−5.3	−1.0
Sept. 2	Cape	54 Sagittarii	I	−0.55	+0.60	+0.19	+0.77	+0.79	+0.13	+0.09	−0.72	−0.47	−3.1	−0.5
2	Cape	e Sagittarii	I	−0.79	+0.87	+0.12	+0.46	+0.47	+0.11	+0.12	−0.40	−0.68	−5.9	−2.2
3	Greenwich	27 G. Capricor.	I	−0.93	+1.00	+0.01	+0.02	+0.02	+0.06	+0.19	−0.02	−0.57	−5.4	−1.0
Oct. 22	Cape	γ Libræ	I	−0.65	−0.17	+0.50	−0.57	−0.76	+0.10	−0.13	+0.63	−0.20	−2.6	+0.4
30	Cobham	ρ Aquarii	I	−0.30	+0.30	−0.80	−0.50	−0.94	−0.25	+0.06	+0.44	−0.29	−1.0	+0.4
30	Greenwich	ρ Aquarii	I	−0.30	+0.30	−0.79	−0.51	−0.94	−0.25	+0.06	+0.42	−0.29	−0.8	+0.6
Nov. 4	Greenwich	ξ Arietis	I	−0.79	−0.03	+0.56	−0.33	+0.66	+0.11	+0.21	+0.41	+0.01	−2.5	+1.2
9	Greenwich	λ Geminor.	E	+1.02	+0.83	+0.09	+0.42	−0.43	+0.16	+0.09	−0.39	−0.79	+0.2	−4.4
Dec. 2	Greenwich	W. B. II 1033	I	−0.58	−0.07	+0.61	−0.58	+0.84	+0.13	+0.14	+0.61	−0.17	−3.4	−0.6
4	Greenwich	318 B. Tauri	IB	−1.03	−0.52	+0.15	−0.41	+0.44	−0.09	+0.08	+0.44	+0.11	−4.6	+0.3
4	Greenwich	318 B. Tauri	EB	+0.92	+0.47	+0.20	−0.55	+0.59	+0.16	−0.06	+0.58	−0.10	+2.3	−1.8
10	Greenwich	d Leonis	IB	−0.53	−0.46	−0.82	−0.30	+0.87	−0.32	−0.11	+0.25	+0.49	−3.4	−0.9
10	Greenwich	d Leonis	E	+0.57	+0.49	−0.79	−0.29	+0.84	−0.19	+0.20	+0.26	−0.52	+2.5	−0.1
31	Greenwich	75 Tauri	I	−0.73	−0.29	+0.33	−0.68	+0.76	+0.01	+0.09	+0.31	−0.29	−2.0	+1.5
31	Greenwich	75 Tauri	EB	+0.58	+0.23	+0.36	−0.77	+0.86	+0.17	−0.06	+0.33	+0.23	+3.8	+1.1
31	Cape	119 H′. Tauri	I	−1.05	−0.36	+0.09	−0.21	+0.23	−0.10	+0.12	+0.22	−0.44	−2.8	+2.2
31	Cape	68 Tauri	I	−0.93	−0.28	−0.22	+0.45	−0.50	−0.17	+0.11	−0.51	−0.39	−6.3	−1.8
1904, Jan. 4	Kasan	29 Cancri	IB	−1.03	−0.87	+0.23	+0.36	−0.43	−0.10	−0.18	−0.35	+0.31	−6.3	−1.4
4	Kasan	29 Cancri	E	+1.07	+0.91	+0.19	+0.30	−0.35	+0.25	+0.17	−0.30	−0.32	+6.6	+1.7
Feb. 24	Kasan	θ^1 Tauri	EB	+0.32	+0.12	+0.36	−0.88	+0.95	+0.15	−0.03	+0.86	+0.30	+0.1	−1.4
24	Utrecht	α Tauri	I	−1.00	−0.39	−0.06	+0.16	−0.17	−0.08	+0.12	−0.16	−0.96	−4.8	0.0
24	Wilhelmshaven	α Tauri	I	−0.99	−0.38	−0.08	+0.21	−0.23	−0.06	+0.11	−0.21	+0.96	−5.8	−1.0
24	Wilhelmshaven	α Tauri	EB	+1.00	+0.38	−0.07	+0.19	−0.20	+0.06	−0.12	−0.19	−0.95	+4.2	−0.4
29	Kasan	o Leonis	I	−1.15	−1.00	+0.06	+0.05	−0.08	−0.19	+0.26	−0.05	−0.27	−6.4	−0.9
29	Kasan	o Leonis	EB	+1.12	+0.97	+0.20	+0.15	−0.25	+0.27	+0.24	−0.16	+0.26	+4.3	−1.0
29	Englehardt	o Leonis	I	−1.15	−1.00	+0.06	+0.04	−0.07	−0.19	+0.25	−0.06	−0.27	−7.2	−1.7
29	Englehardt	o Leonis	EB	+1.12	+0.97	+0.20	+0.14	−0.25	+0.16	+0.23	−0.15	+0.26	+6.6	+1.4
Mar. 4	Cape	l Virginis	E	+0.79	+0.38	+0.64	−0.28	−0.69	+0.31	+0.18	+0.29	−0.40	+2.8	−0.9
22	Greenwich	θ^1 Tauri	I	−0.67	−0.22	+0.26	−0.70	+0.74	−0.04	+0.10	+0.69	−0.64	−2.8	+0.5
22	Greenwich	75 Tauri	I	−0.62	−0.16	−0.27	+0.73	−0.78	−0.02	+0.08	−0.72	−0.60	−4.4	−1.4
22	Kasan	γ Tauri	I	−0.47	−0.12	+0.34	−0.81	+0.88	+0.09	+0.08	+0.78	−0.76	−5.7	−3.4
22	Kasan	γ Tauri	EB	+0.56	+0.17	+0.31	−0.77	+0.83	+0.14	−0.07	+0.77	+0.58	+4.0	+1.4
22	Englehardt	γ Tauri	I	−0.44	+0.21	+0.32	−0.83	+0.90	+0.13	+0.09	+0.64	+0.67	−5.1	−2.9
27	Kasan	209 B. Cancri	I	−0.34	−0.30	−0.70	−0.64	+0.95	−0.25	−0.05	+0.69	−0.22	−4.6	−2.9
27	Englehardt	209 B. Cancri	EB	+0.51	+0.45	−0.66	−0.60	+0.89	−0.11	+0.12	+0.64	+0.32	−2.4	−4.8
Apr. 22	Cape	2 B. Cancri	I	−0.98	−0.78	−0.21	−0.33	+0.39	−0.15	−0.13	−0.58	−0.92	−3.0	+1.8
24	Kasan	83 B. Leonis	I	−0.96	−0.88	+0.42	+0.25	−0.48	−0.01	−0.25	−0.26	−0.79	−3.5	+1.2
24	Greenwich	10 Sextantis	I	−1.06	−0.97	−0.20	−0.11	+0.23	−0.11	−0.24	+0.11	−0.88	−4.9	+0.3
28	Englehardt	m Virginis	I	−0.74	−0.41	+0.63	−0.36	−0.73	+0.11	−0.23	+0.31	−0.17	−0.7	+2.9
May 1	Cape	φ Ophiuchi	E	+1.01	−0.12	+0.05	−0.16	−0.17	+0.10	+0.13	+0.37	−0.38	+5.5	+0.7
21	Kasan	o Leonis	I	−0.97	−0.90	−0.36	−0.22	+0.42	−0.22	−0.22	+0.28	−0.91	−3.0	+1.8
24	Cape	η Virginis	I	−1.08	−0.87	−0.02	0.00	+0.02	−0.14	−0.31	−0.02	−0.87	−6.9	−1.6
June 4	Cape	ρ Aquarii	E	+0.81	−0.90	−0.42	−0.16	−0.44	−0.16	−0.26	+0.21	−0.88	+5.3	+1.5
July 7	Cape	38 Arietis	E	+0.96	−0.45	−0.09	+0.10	−0.13	−0.01	−0.04	−0.08	−0.84	+3.6	−1.0
9	Greenwich	θ^1 Tauri	E	+1.03	+0.08	+0.02	−0.07	+0.07	+0.16	−0.14	+0.41	−0.58	+7.4	+2.5
9	Greenwich	θ^2 Tauri	E	+0.93	+0.09	+0.11	−0.41	+0.43	−0.03	−0.16	+0.09	−0.52	+6.9	+2.5
9	Greenwich	264 B. Tauri	IB	−0.86	−0.08	−0.14	+0.52	−0.54	−0.04	+0.13	−0.47	+0.49	−6.9	−2.6
9	Greenwich	α Tauri	IB	−0.76	−0.07	−0.16	+0.65	−0.67	−0.05	+0.10	−0.63	+0.41	−5.5	−1.7
9	Greenwich	α Tauri	E	+0.88	+0.08	−0.12	+0.51	−0.53	+0.06	−0.12	−0.76	−0.48	+4.7	+0.5
18	Cape	38 Virginis	I	−0.54	−0.42	−0.80	+0.32	−0.86	−0.33	−0.12	−0.20	−0.48	−2.4	+0.3
22	Cape	φ Ophiuchi	I	−0.95	−0.03	−0.06	+0.23	+0.24	−0.06	−0.13	−0.24	−0.83	−4.1	+0.6
Aug. 30	Greenwich	ξ^1 Ceti	E	+0.92	−0.02	+0.01	−0.01	+0.02	−0.07	−0.25	+0.04	−0.87	+5.4	+1.0
Sept. 13	Cape	13 Libræ	I	−1.06	−0.52	−0.11	+0.16	+0.19	−0.17	−0.23	−0.16	−0.68	−5.1	+0.2
22	Cape	67 Aquarii	I	−0.79	+0.87	+0.46	+0.08	+0.47	+0.18	+0.27	−0.19	−0.40	−5.9	−1.9
27	Utrecht	85 Ceti	E	+0.93	−0.53	+0.03	+0.04	−0.04	−0.02	−0.25	0.00	−0.62	+4.4	−0.1
29	Cobham	γ Tauri	E	+0.81	−0.10	−0.12	+0.53	−0.54	−0.07	−0.14	−0.53	−0.75	+4.1	+0.2
29	Cobham	θ^1 Tauri	E	+0.95	−0.10	+0.03	−0.16	+0.16	+0.04	−0.14	+0.17	−0.88	+3.0	−1.6

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1904, Sept. 29	Cobham	θ^2 Tauri	E	+0.83	−0.09	+0.10	−0.51	+0.52	+0.09	−0.12	−0.50	−0.77	+3.4	−0.6
29	Greenwich	θ^1 Tauri	IB	−0.96	+0.10	−0.01	+0.02	−0.02	0.00	+0.15	−0.04	+0.88	−5.3	−0.5
29	Greenwich	θ^1 Tauri	E	+0.95	−0.10	+0.03	−0.15	+0.16	0.00	−0.15	+0.15	−0.87	+4.1	−0.5
29	Greenwich	θ^2 Tauri	IB	−0.90	+0.09	+0.07	−0.34	−0.35	−0.01	+0.15	+0.30	+0.83	−2.2	+2.3
29	Greenwich	θ^2 Tauri	E	+0.83	−0.09	+0.09	−0.51	+0 51	−0.01	−0.13	+0.47	−0.76	+4.2	+0.2
29	Greenwich	264 B. Tauri	IB	−0.85	+0.09	−0.09	+0.46	−0.47	0.00	+0.14	−0.40	−0.36	−5.6	−1.4
29	Greenwich	γ Tauri	E	+0.81	−0.08	−0.12	+0.53	−0.54	0.00	−0.14	−0.48	−0.74	+4.2	+0.3
29	Greenwich	71 Tauri	E	+0.37	−0.04	+0.18	−0.91	+0.92	0.00	−0.05	+0.85	−0.33	+2.1	+0.3
Oct. 27	Cape	m Tauri	E	+0.81	−0.06	+0.01	+0.56	−0.56	−0.03	−0.09	−0.52	−0.60	+3.9	0.0
Nov. 20	Cobham	64 Ceti	I	−0.86	+0.66	+0.27	−0.30	+0.40	+0.12	+0.27	+0.17	−0.37	−4.0	+0.4
20	Cobham	ξ^1 Ceti	I	−0.94	+0.72	+0.01	−0.01	+0.01	+0.01	+0.28	−0.03	−0.41	−4.4	+0.4
20	Greenwich	64 Ceti	I	−0.86	+0.66	+0.27	−0.30	+0.40	+0.05	+0.27	+0.17	−0.34	−3.8	+0.8
20	Greenwich	ξ^1 Ceti	I	−0.94	+0.68	+0.01	−0.01	+0.01	+0.01	+0.28	−0.04	−0.37	−4.8	0.0
23	Kasan	α Tauri	E	+0 61	−0.11	−0.08	+0.78	−0.79	−0.08	−0.10	−0.73	−0.11	+4.4	+1.4
Dec. 16	Cape	77 Piscium	I	−0.82	+0.84	−0.38	+0.24	−0.44	−0.11	+0.26	−0.13	−0.83	−5.4	−1.2
20	Greenwich	γ Tauri	I	−0.97	+0.29	+0.03	−0.17	+0.17	−0.02	+0.16	+0.11	−0.36	−4.7	+0.2
20	Greenwich	γ Tauri	EB	+0.92	−0.27	+0.06	−0.36	+0.37	+0.03	−0.14	+0.36	+0.34	+3.3	−1.2
20	Greenwich	70 Tauri	I	−0.92	+0.27	+0.05	−0.37	+0.38	−0.03	+0.15	+0.32	−0.34	−2.3	+2.4
20	Greenwich	75 Tauri	I	−0.77	+0.23	−0.07	+0.62	−0.63	−0.02	+0.11	−0.59	−0.29	−4.0	−0.1
20	Greenwich	B. D. +15° 633	I	−0.97	+0.28	+0.02	−0.20	+0.20	−0.03	+0.16	+0.17	−0.36	−4.8	+0.1
20	Greenwich	θ^1 Tauri	I	−0.45	+0.13	+0.10	−0.89	+0.89	−0.02	+0.08	+0.80	−0.17	−3.0	−0.7
20	Greenwich	θ^1 Tauri	EB	+0.40	−0.12	+0.10	−0.91	+0.92	+0.01	−0.06	+0.85	+0.15	−0.5	−2.5
20	Greenwich	264 B. Tauri	I	−0.95	+0.28	+0.03	−0.30	+0.30	−0.03	+0.13	+0.28	−0.35	−2.6	+2.2
20	Greenwich	α Tauri	I	−0.91	+0.26	−0.03	+0.41	−0.41	−0.04	+0.12	−0.41	−0.34	−4.1	+0.5
20	Cobham	75 Tauri	I	−0.78	+0.20	−0.07	+0.62	−0.62	+0.14	+0.14	−0.58	−0.29	−3.3	+0.7
20	Utrecht	75 Tauri	I	−0.76	+0.22	−0.07	+0.63	−0 64	−0.13	+0.11	−0.60	−0.28	−4.5	−0.6
20	Kasan	θ^1 Tauri	I	−0.84	+0.18	+0.06	−0.53	+0.53	+0.04	+0.06	+0.52	−0.31	−4.7	−0.4
20	Kasan	θ^2 Tauri	I	−0.49	+0.11	+0.09	−0.87	+0.87	+0.11	+0.08	+0.55	−0.18	−4.2	−1.7
20	Kasan	48 Tauri	I	−0.78	+0.23	+0.10	−0.60	+0.61	+0.06	−0.27	+0.52	−0.29	−6.5	−2.5
20	Kasan	γ Tauri	I	−0.76	+0.22	+0.10	−0.64	+0.64	+0.07	+0.13	+0.55	−0.28	−5.4	−1.5
20	Englehardt	48 Tauri	I	−0.78	+0.23	+0.10	−0.60	+0.61	+0.07	+0.15	+0.51	−0.30	−5.8	−1.8
20	Englehardt	γ Tauri	I	−0.76	+0.22	+0.10	−0.63	+0.64	+0.07	+0.14	+0.55	−0.28	−4.5	−0.6
20	Englehardt	θ^1 Tauri	I	−0.84	+0.18	+0.06	−0.53	+0.54	+0.02	+0.14	+0.45	−0.31	−3.7	+0.6
20	Englehardt	θ^2 Tauri	I	−0.49	+0.11	+0.09	−0.87	+0.87	+0.11	+0.08	+0.78	−0.18	−3.8	−1.3
20	Englehardt	θ^2 Tauri	EB	+0.58	−0.13	+0.08	−0.81	+0.81	+0.14	−0.08	+0.76	+0.22	+1.2	−1.6
1905, Jan. 10	Greenwich	φ Aquarii	I	−0.82	+0.86	−0.46	+0.03	−0 46	−0.11	+0.25	+0.09	−0.73	−4.6	−0.4
10	Greenwich	φ Aquarii	EB	+0.87	−0.94	−0.22	+0.02	−0.22	−0.11	−0.31	+0.07	+0.80	+2.9	−1.4
16	Tokio	264 B. Tauri	IB	−0.97	+0.29	0.00	+0.03	−0.03	−0.03	+0.15	−0.05	−0.65	−8.1	−3.2
16	Tokio	269 B. Tauri	IB	−0.95	+0.28	+0.02	−0.20	+0.20	+0.01	+0.15	+0.17	−0.64	−6.5	−1.7
16	Tokio	264 B. Tauri	E	+0.93	−0.27	+0.02	−0.27	+0.27	+0.06	−0.15	+0.28	+0.62	+3.1	−1.5
17	Tokio	α Tauri	IB	−0.97	+0.29	+0.01	−0.10	+0.10	−0.01	+0.15	+0.06	−0.65	−6.6	−1.7
17	Tokio	α Tauri	E	+0.96	−0.29	+0.01	−0.16	+0.16	+0.05	−0.14	+0.18	+0.64	+5.5	+0.8
17	Greenwich	318 B. Tauri	I	−0.73	+0.15	+0.02	+0.71	−0.71	−0.12	+0.08	−0.69	−0.45	−5.1	−1.4
18	Kasan	130 Tauri	I	−0.87	−0.03	−0.12	−0.48	+0.49	−0.02	+0.04	+0.47	−0.37	−5.9	−1.5
18	Greenwich	130 Tauri	I	−1.04	−0.02	−0.06	−0.25	+0.26	−0.06	+0.05	+0.25	−0.45	−6.2	−0.9
19	Greenwich	26 Geminor.	I	−0.74	−0.16	−0.34	−0.67	+0.75	−0.08	−0.01	+0.71	−0.18	−5.0	−1.2
26	Cape	80 Virginis	E	+1.04	+0.90	−0.19	+0.17	+0.25	−0.05	+0.31	−0.06	−0.93	+4.2	+0.9
Feb. 13	Utrecht	θ^1 Tauri	I	−0.89	+0.32	−0.03	+0.36	−0.38	−0.07	+0.14	−0.37	−0.87	−3.1	+1.4
13	Kasan	70 Tauri	I	−0.69	+0.23	−0.05	+0.69	−0.69	−0.11	+0.11	−0.66	−0.94	−3.9	−0.4
13	Kasan	71 Tauri	I	−0.69	+0.24	+0.05	−0.65	+0.65	+0.13	+0.13	+0.57	−0.71	−3.9	−0.4
17	Utrecht	23 H[1]. Cancri	I	−1.01	−0.53	−0.24	−0.20	+0.31	−0.16	−0.15	+0.26	−0.35	−5.8	−0.6
20	Tokio	c Leonis	E	+0.92	+0.79	−0.54	+0.02	+0.54	−0.03	+0.28	+0.19	−0.18	+5.6	+1.1
21	Utrecht	η Virginis	E	+0.82	+0.72	−0.64	+0.27	+0.70	−0.08	+0.27	−0.02	−0.37	+4.8	+0.8
Mar. 10	Kasan	389 B. Ceti	I	−0.86	+0.76	−0.18	+0.29	−0.34	−0.06	+0.25	−0.24	−0.76	−4.8	−0.3
12	Greenwich	48 Tauri	I	−0.96	+0.42	+0.01	−0.14	+0.14	+0.04	+0.17	+0.09	−0.98	−6.1	−1.1
15	Utrecht	110 B. Geminor.	I	−0.93	−0.24	+0.25	+0.35	−0.43	−0.06	−0.04	−0.45	−0.79	−3.9	+0.9
16	Greenwich	2 B. Cancri	I	−1.03	−0.45	−0.27	+0.21	−0.34	−0.06	−0.11	−0.34	−0.70	−4.3	+1.1
17	Cape	o^1 Cancri	I	−1.04	−0.55	+0.28	+0.14	−0.31	−0.08	−0.19	−0.28	−0.58	−5.4	0.0
18	Tokio	44 Leonis	I	−0.78	−0.62	−0.68	−0.08	+0.69	−0.29	−0.17	+0.29	−0.25	−8.2	−4.1
19	Greenwich	56 Leonis	I	−1.07	−0.85	−0.39	0.00	+0.39	−0.30	−0.25	+0.11	−0.21	−3.3	+2.3
20	Utrecht	β Virginis	I	−0.84	−0.74	−0.62	+0.22	+0.65	−0.33	−0.21	+0.03	−0.03	−7.3	−2.9
20	Utrecht	β Virginis	EB	+0.94	+0.83	−0.50	+0.18	+0.53	−0.03	+0.29	+0.08	+0.03	+4.0	−0.7
Apr. 12	Kasan	162 B. Geminor.	I	−0.98	−0.33	−0.23	−0.24	+0.34	−0.12	−0.08	+0.29	−0.93	−3.5	+1.6
12	Englehardt	162 B. Geminor.	I	−0.98	−0.33	−0.23	−0.24	+0.34	−0.12	−0.08	+0.29	−0.93	−4.0	+1.1
12	Englehardt	162 B. Geminor.	EB	+1.02	+0.34	−0.13	−0.13	+0.18	+0.07	+0.09	+0.19	+0.97	+4.4	−0.7
12	Greenwich	162 B. Geminor.	I	−0.03	−0.01	−0.69	−0.72	+1.00	−0.08	0.00	+0.93	−0.03	−0.6	−0.4
15	Greenwich	44 Leonis	I	−1.11	−0.88	+0.09	+0.01	−0.09	−0.14	−0.27	−0.08	−0.68	−8.6	−2.8
15	Greenwich	44 Leonis	EB	+1.07	+0.84	+0.29	+0.01	−0.29	+0.23	+0.25	−0.09	+0.65	+8.0	+2.6
16	Cape	σ Leonis	I	−0.67	+0.57	+0.79	−0.14	−0.81	+0.14	−0.22	−0.23	−0.32	−4.0	−0.5
17	Greenwich	η Virginis	I	−0.87	−0.76	−0.59	+0.28	+0.65	−0.36	−0.21	−0.06	−0.28	−7.5	−3.0

GROUP XIII—1891-1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1905, Apr.	24	Cape	ρ Sagittarii	E	+0.94	−0.02	−0.21	−0.24	−0.32	+0.02	−0.07	+0.38	−0.87	+ 4.4	−0.3
May	10	Cape	ζ Cancri	I	−0.95	+0.43	+0.27	+0.19	−0.35	−0.01	−0.13	−0.34	−0.98	− 5.5	−0.5
	10	Cape	Pi. VIII 6	I	−0.95	+0.43	+0.27	+0.19	−0.35	−0.01	−0.13	−0.35	−0.93	− 5.6	−0.6
	13	Kasan	56 Leonis	I	−0.34	−0.28	−0.95	+0.10	+0.95	−0.33	−0.05	+0.29	−0.28	− 3.8	−2.0
	13	Kasan	c Leonis	I	−1.03	−0.86	+0.35	−0.04	−0.35	−0.04	−0.29	−0.14	−0.85	− 4.7	+0.7
	14	Kasan	β Virginis	I	−0.62	−0.54	−0.78	+0.28	+0.83	−0.36	−0.14	+0.04	−0.44	− 2.7	+0.6
	15	Greenwich	38 Virginis	I	−0.17	−0.15	−0.79	+0.59	+0.99	−0.35	0.00	−0.20	−0.10	− 2.4	−1.5
	15	Greenwich	38 Virginis	EB	+0.40	+0.36	−0.74	+0.56	+0.93	−0.24	+0.17	−0.20	+0.23	+ 0.6	−1.4
	15	Greenwich	k Virginis	I	−0.96	−0.85	+0.41	−0.32	−0.52	+0.01	−0.30	+0.10	−0.54	− 4.2	+0.8
July	7	Cape	σ Leonis	I	−0.27	+0.23	−0.93	+0.25	+0.97	−0.33	−0.03	+0.21	−0.23	− 4.0	−2.6
	13	Englehardt	29 Ophiuchi	I	−0.76	−0.43	+0.15	+0.69	+0.70	−0.17	−0.09	−0.71	−0.44	− 3.9	+0.1
	20	Cape	337 B. Aquarii	E	+0.72	+0.63	−0.62	+0.20	−0.63	−0.20	−0.27	+0.15	−0.59	+ 4.5	+0.8
Aug.	7	Cape	15 Libræ	I	−0.91	−0.29	−0.15	+0.50	+0.52	−0.24	−0.21	−0.44	−0.86	− 4.4	+0.4
	12	Tokio	226 B. Sagittarii	I	−0.98	−0.26	−0.24	−0.23	−0.33	−0.11	+0.06	+0.28	−0.95	− 2.4	+2.8
	17	Jena	27 Piscium	IB	−0.90	+0.88	−0.05	+0.03	−0.06	+0.02	+0.32	−0.05	+0.48	− 8.9	−4.1
	23	Jena	89 Tauri	E	+0.90	−0.63	−0.04	−0.24	+0.24	0.00	−0.10	+0.21	−0.94	− 0.4	−5.0
	23	Jena	σ² Tauri	E	+0.40	−0.28	−0.14	−0.89	+0.90	+0.13	−0.06	+0.86	−0.42	+ 2.8	+0.8
Sept.	9	Königsberg	B. D. −18° 5646	I	−0.96	−0.01	−0.37	−0.19	−0.29	−0.10	+0.13	+0.22	−0.77	+ 0.6	+5.8
	11	Tokio	σ Aquarii	EB	+0.83	−0.48	+0.47	−0.04	+0.47	+0.13	−0.23	−0.18	+0.34	+ 1.9	−2.4
	12	Cape	λ Aquarii	I	−0.61	−0.43	−0.74	+0.15	−0.76	−0.21	+0.15	+0.26	−0.12	− 2.6	+0.6
	12	Cape	λ Aquarii	EB	+0.83	+0.58	−0.44	+0.10	−0.45	−0.15	−0.26	+0.18	+0.16	+ 3.4	−0.9
	17	Jena	μ Ceti	IB	−0.84	+0.89	−0.11	+0.34	−0.36	−0.07	+0.25	−0.27	+0.67	− 6.7	−2.2
	17	Jena	μ Ceti	E	+0.88	−0.95	−0.05	+0.14	−0.15	−0.09	−0.29	−0.05	−0.71	+ 5.9	+1.4
	17	Utrecht	μ Ceti	IB	−0.78	−0.84	−0.15	+0.46	−0.48	−0.08	+0.23	−0.35	+0.63	− 8.7	−4.5
	17	Utrecht	μ Ceti	E	+0.85	−0.92	−0.09	+0.28	−0.29	−0.13	−0.28	−0.15	−0.69	+ 4.8	+0.4
	18	Utrecht	f Tauri	IB	−0.89	+0.88	−0.02	+0.16	−0.16	0.00	+0.23	−0.16	+0.84	− 9.3	−4.6
	18	Utrecht	f Tauri	E	+0.90	−0.89	0.00	−0.01	+0.01	−0.04	−0.24	+0.06	−0.85	+ 7.6	+2.9
	18	Königsberg	f Tauri	IB	−0.90	+0.88	−0.28	+0.04	−0.04	+0.03	+0.24	−0.09	+0.85	− 6.4	−1.5
	18	Königsberg	B. D. +12° 485	E	+0.49	−0.48	+0.94	−0.11	+0.84	+0.18	−0.11	+0.70	−0.46	+11.1	+8.4
	18	Königsberg	f Tauri	E	+0.54	−0.53	+0.91	−0.11	+0.80	+0.16	−0.12	+0.67	−0.51	+ 3.7	+0.9
	18	Jena	f Tauri	E	+0.89	−0.87	+0.01	−0.13	+0.13	−0.01	−0.23	+0.15	−0.84	+ 8.0	+3.3
	19	Jena	γ Tauri	IB	−0.53	+0.44	+0.08	+0.81	−0.81	−0.13	+0.10	−0.76	+0.55	− 4.8	−2.0
	19	Jena	γ Tauri	E	+0.66	−0.54	+0.08	+0.69	−0.70	−0.15	−0.15	−0.59	−0.66	+ 4.3	+0.9
	19	Greenwich	θ¹ Tauri	E	+0.93	−0.71	−0.03	−0.19	+0.19	0.00	−0.16	+0.22	−0.92	+ 1.6	−3.2
Oct.	4	Greenwich	B.F. 2471	I	−1.02	−0.50	−0.20	−0.31	−0.37	−0.08	−0.04	+0.35	−0.89	− 2.1	+3.4
	4	Königsberg	B. D. −19° 4858	I	−1.03	−0.81	−0.11	−0.18	−0.25	−0.11	−0.04	+0.20	−0.91	− 1.1	+4.3
	4	Königsberg	B. D. −20° 5003	I	−0.87	−0.67	+0.33	+0.51	+0.58	−0.12	−0.03	−0.62	−0.77	− 3.4	+1.3
	4	Königsberg	B. D. −19° 4863	I	−1.03	−0.81	−0.10	−0.15	−0.22	−0.11	−0.04	+0.17	−0.91	− 0.9	+4.6
	4	Königsberg	B. D. −20° 5041	I	−0.98	−0.75	+0.23	+0.35	+0.38	−0.12	−0.04	−0.43	−0.86	− 2.0	+3.3
	4	Königsberg	38 G. Sagittarii	I	−1.00	−0.81	−0.14	−0.22	−0.30	−0.09	−0.04	−0.27	−0.89	− 2.4	+3.0
	11	Englehardt	5 Ceti	I	−0.05	+0.05	−0.84	+0.54	−1.00	−0.33	−0.04	−0.01	−0.02	− 1.6	−1.3
	11	Englehardt	5 Ceti	EB	+0.39	−0.37	−0.76	+0.49	−0.90	−0.20	−0.00	0.00	+0.16	− 2.3	−4.3
Nov.	7	Greenwich	27 Piscium	I	−0.85	+0.68	−0.45	+0.26	−0.52	−0.19	+0.30	−0.01	−0.66	− 4.5	+0.1
	7	Greenwich	27 Piscium	EB	+0.90	−0.72	−0.04	+0.02	−0.04	−0.18	+0.39	+0.09	+0.70	+ 3.1	−1.6
	7	Greenwich	29 Piscium	I	−0.25	+0.22	−0.81	+0.51	−0.96	−0.39	+0.03	+0.03	−0.20	− 1.0	+0.4
	7	Greenwich	29 Piscium	EB	+0.32	−0.29	−0.78	+0.51	−0.93	−0.39	−0.22	+0.06	+0.27	+ 2.0	+0.3
Dec.	2	Cape	37 Aquarii	I	−0.26	−0.09	−0.95	+0.09	−0.96	−0.26	+0.04	+0.47	−0.24	− 1.5	−0.1
	9	Greenwich	f Tauri	I	−0.76	+0.77	+0.02	−0.57	+0.57	+0.22	+0.37	+0.30	−0.32	− 5.4	−1.2
	10	Cape	64 Tauri	I	−0.47	−0.42	+0.15	+0.84	−0.86	−0.14	+0.08	−0.77	−0.10	− 2.3	+0.3
	10	Utrecht	γ Tauri	I	−0.89	+0.86	−0.02	−0.13	+0.13	+0.07	+0.19	+0.08	−0.25	− 5.6	−0.7
1906, Jan.	1	Königsberg	B. D. −3° 14	I	−0.89	+0.72	−0.08	+0.06	+0.24	+0.10	+0.34	−0.07	−0.94	− 6.0	−1.1
	4	Greenwich	ξ² Ceti	I	−0.77	+0.86	+0.15	−0.49	+0.52	+0.19	+0.27	+0.26	−0.80	− 6.1	−1.9
	4	Jena	ξ² Ceti	I	−0.59	+0.66	+0.22	−0.72	+0.75	+0.26	+0.23	+0.43	−0.61	− 5.1	−1.9
	6	Tokio	α Tauri	I	−0.90	+0.88	−0.01	−0.05	+0.05	+0.05	+0.18	0.00	−0.61	− 6.7	−1.7
	10	Greenwich	g Geminor.	IB	−0.38	+0.08	+0.80	+0.45	−0.92	+0.07	−0.04	−0.86	+0.05	− 7.5	−5.4
	13	Tokio	α Leonis	IB	−1.02	−0.38	+0.18	−0.02	−0.18	−0.05	−0.28	−0.14	+0.63	− 5.8	−0.2
	13	Tokio	α Leonis	E	+1.01	+0.38	+0.23	−0.02	−0.23	+0.15	+0.25	−0.07	−0.62	+ 5.9	+0.5
Feb.	3	Greenwich	α Tauri	I	−0.68	+0.67	+0.19	+0.62	−0.65	−0.07	+0.12	−0.66	−0.68	− 5.4	−1.6
	3	Greenwich	α Tauri	EB	+0.79	−0.77	+0.14	+0.45	−0.47	−0.12	−0.17	−0.38	+0.78	+ 5.3	+1.1
	4	Greenwich	115 Tauri	I	−0.86	+0.77	−0.16	−0.30	+0.34	+0.06	+0.12	+0.27	−0.71	− 5.2	−0.4
	4	Greenwich	115 Tauri	EB	+0.77	−0.70	−0.26	−0.46	+0.53	+0.03	−0.09	+0.57	+0.65	− 0.7	−4.8
	7	Greenwich	ζ Cancri	I	−0.96	+0.14	+0.21	+0.09	−0.23	−0.14	+0.27	−0.57	−0.22	− 5.2	+0.1
	8	Königsberg	π Cancri	I	−0.66	−0.09	+0.61	+0.06	−0.76	+0.11	−0.15	−0.56	+0.02	− 2.9	+0.7
Mar.	2	Greenwich	θ² Tauri	I	−0.39	+0.39	−0.27	−0.86	+0.90	+0.17	+0.09	+0.80	−0.43	− 4.3	−2.1
	3	Cape	m Tauri	I	−0.35	−0.30	−0.40	−0.82	+0.92	+0.13	+0.06	+0.91	−0.36	− 3.9	−1.9
	4	Cape	57 Orionis	I	−0.86	−0.58	+0.25	+0.29	−0.39	−0.01	+0.05	−0.33	−0.75	− 5.0	−0.2
	17	Cape	γ Sagittarii	E	+0.56	−0.40	−0.60	−0.62	−0.85	+0.09	+0.02	+0.86	−0.52	+ 0.8	−2.2
	20	Cape	29 Capricor.	E	+0.97	−0.18	+0.16	+0.01	+0.16	+0.08	−0.20	+0.36	−0.74	+ 3.0	−2.2
	29	Greenwich	179 B. Tauri	I	−0.71	+0.77	−0.14	−0.58	+0.60	+0.17	+0.19	+0.47	−0.62	− 5.8	−1.8
	29	Königsberg	α Tauri	EB	+0.79	−0.81	+0.10	+0.29	−0.47	−0.12	−0.16	−0.39	+0.79	+ 5.3	+1.0

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ι	P	n	n'
													$''$	$''$
1906, Mar. 31	Tokio	71 Orionis	I	−0.50	+0.35	−0.59	−0.60	+0.84	+0.07	+0.04	+0.79	−0.54	−3.6	−0.8
Apr. 2	Cape	61 Geminor.	I	−0.35	−0.13	+0.81	+0.43	−0.93	+0.05	−0.03	+0.02	−0.36	+0.1	+2.1
2	Königsberg	B.D.+18° 1616	I	−0.28	+0.11	−0.84	−0.48	+0.96	−0.06	−0.01	+0.89	−0.28	−4.4	−2.8
2	Königsberg	Berlin A. 2834	I	−0.31	+0.12	−0.84	−0.48	+0.95	−0.06	−0.02	+0.89	−0.31	−4.2	−2.5
2	Königsberg	B.D.+18° 1618	I	−0.28	+0.11	−0.84	−0.48	+0.96	−0.06	−0.01	+0.89	−0.28	−4.5	−2.9
2	Königsberg	B.D.+18° 1640	I	−0.96	+0.37	−0.13	−0.07	+0.08	−0.02	−0.06	+0.02	−0.96	−6.8	−1.4
2	Königsberg	B.D.+18° 1641	I	−0.95	+0.37	−0.16	−0.09	+0.12	−0.02	−0.06	+0.06	−0.95	−9.3	−4.0
2	Königsberg	B.D.+18° 1652	I	−0.93	+0.36	−0.28	−0.14	+0.25	−0.03	−0.06	+0.18	−0.93	−6.8	−1.6
2	Königsberg	B.D.+18° 1653	I	−0.70	+0.27	−0.64	−0.33	+0.68	−0.04	−0.04	+0.61	−0.70	−7.1	−3.2
3	Greenwich	d^2 Cancri	I	−0.90	+0.13	−0.40	−0.10	+0.41	−0.09	−0.12	+0.29	−0.80	−3.9	+1.1
4	Greenwich	π Cancri	I	−0.96	−0.04	−0.29	−0.02	+0.29	−0.11	−0.18	+0.14	−0.73	−7.2	−1.8
4	Jena	π Cancri	I	−0.98	−0.07	−0.23	−0.01	+0.23	−0.12	−0.20	+0.11	−0.75	−6.2	−0.6
4	Königsberg	π Cancri	I	−1.01	−0.06	−0.17	−0.01	−0.05	−0.06	−0.22	−0.08	−0.77	−6.6	−1.0
5	Königsberg	α Leonis	I	−0.48	−0.13	+0.68	−0.12	−0.88	+0.19	−0.19	−0.45	−0.30	−0.5	+2.2
5	Königsberg	α Leonis	EB	+0.30	+0.08	+0.98	−0.18	−0.96	+0.27	+0.04	−0.48	+0.18	+5.8	+4.2
5	Jena	α Leonis	EB	+0.73	+0.21	+0.70	−0.13	−0.71	+0.25	+0.16	−0.34	+0.44	+4.4	+0.5
5	Greenwich	α Leonis	EB	+0.77	+0.20	+0.66	−0.12	−0.67	+0.23	+0.17	−0.31	+0.47	+5.2	+1.0
6	Greenwich	χ Leonis	I	−0.90	−0.43	−0.47	+0.22	+0.52	−0.39	−0.34	+0.15	−0.39	−5.2	−0.2
6	Jena	χ Leonis	I	−0.85	−0.41	−0.54	+0.24	+0.59	−0.27	−0.22	+0.14	−0.36	−5.9	−1.1
6	Washington	σ Leonis	I	−0.56	−0.30	−0.75	+0.43	+0.86	−0.35	−0.12	+0.14	−0.18	−3.8	−0.7
6	Washington	σ Leonis	EB	+0.81	+0.44	−0.58	+0.34	+0.67	−0.09	+0.26	+0.20	+0.26	+3.3	−1.1
6	Königsberg	χ Leonis	I	−1.00	−0.47	−0.54	+0.25	+0.31	−0.21	−0.28	+0.05	−0.43	−7.3	−1.7
6	Königsberg	B.D.+7° 2412	I	−0.86	−0.41	−0.73	+0.34	+0.57	−0.27	−0.23	+0.13	−0.37	−6.8	−2.0
10	Cape	18 Libræ	E	+1.10	−0.96	+0.03	−0.30	−0.30	+0.29	+0.25	+0.26	−0.40	+6.2	+0.3
11	Jena	49 Libræ	E	+0.92	+0.82	+0.11	+0.55	+0.56	+0.03	+0.19	−0.44	−0.50	+2.1	−2.9
14	Cape	190 B. Sagittarii	E	+0.94	−0.61	−0.38	−0.25	−0.45	+0.08	−0.03	+0.49	−0.85	+2.7	−2.4
27	Greenwich	119 Tauri	I	−0.91	+0.82	+0.01	+0.02	−0.02	+0.03	+0.10	−0.07	−0.78	−6.3	−1.2
27	Greenwich	120 Tauri	I	−0.87	+0.79	−0.16	−0.22	+0.27	+0.07	+0.17	+0.14	−0.75	−6.1	−1.2
May 1	Kasan	o^2 Cancri	I	−0.26	+0.01	−0.96	−0.09	+0.96	−0.18	−0.04	+0.70	−0.28	−6.0	−4.5
2	Washington	α Leonis	I	−0.92	−0.26	+0.43	−0.09	−0.44	+0.04	−0.25	−0.27	−0.79	−3.6	+1.6
3	Washington	χ Leonis	I	−0.98	−0.48	−0.36	+0.18	+0.39	−0.24	−0.27	+0.05	−0.69	−3.8	+1.7
8	Washington	η Libræ	IB	0.00	0.00	+0.10	+1.00	+1.00	−0.23	+0.03	−0.83	0.00	−0.3	−0.3
8	Washington	η Libræ	E	+0.32	+0.28	+0.09	+0.96	+0.96	−0.18	+0.10	−0.77	−0.06	+1.3	−0.4
9	Cape	φ Ophiuchi	E	+1.07	−0.90	−0.12	−0.35	−0.37	+0.26	+0.17	+0.40	−0.30	+5.6	−0.2
11	Washington	36 Sagittarii	E	+0.97	+0.61	−0.39	−0.27	−0.47	+0.14	−0.01	+0.52	−0.66	+2.6	−2.6
17	Cape	4 Ceti	E	+0.73	+0.36	−0.45	+0.44	−0.63	−0.21	−0.30	+0.05	−0.68	+2.8	−1.2
June 2	Washington	65 Virginis	I	−0.57	−0.47	−0.33	+0.78	+0.85	−0.37	−0.13	−0.32	−0.35	−5.4	−2.2
4	Cape	18 Libræ	I	−1.10	+0.95	+0.01	−0.26	−0.27	−0.12	−0.29	+0.12	−0.44	−7.5	−1.3
7	Jena	μ Sagittarii	E	+1.07	+0.82	+0.13	+0.12	+0.18	+0.14	+0.05	−0.15	−0.20	+7.6	+1.8
8	Kasan	π Sagittarii	E	+1.08	+0.70	−0.01	−0.01	−0.01	+0.14	−0.04	+0.07	−0.40	+8.0	+2.1
25	Washington	7 Leonis	I	−0.96	−0.02	+0.14	−0.02	−0.14	+0.01	−0.24	−0.15	−0.81	−4.5	+0.9
July 2	Jena	γ Libræ	I	−0.79	−0.71	−0.12	−0.69	−0.70	+0.05	−0.21	+0.52	−0.50	−3.6	+0.8
2	Königsberg	8 Libræ	I	−0.48	−0.43	−0.13	−0.75	−0.90	+0.15	−0.14	+0.70	−0.30	−4.5	−1.8
5	Kasan	115 B. Sagittarii	I	−0.36	−0.46	+0.66	+0.49	+0.82	−0.10	−0.01	−0.84	−0.60	−7.6	−4.0
5	Kasan	121 B. Sagittarii	I	−0.96	−0.70	−0.38	−0.28	−0.47	−0.12	−0.01	+0.42	−0.88	−5.1	+0.4
8	Cape	μ Capricor.	E	+1.03	−0.23	−0.16	+0.03	−0.15	+0.07	−0.26	+0.14	−0.32	+1.8	−3.8
Aug. 9	Cape	ν Piscium	E	+0.80	+0.62	+0.15	−0.48	+0.51	+0.16	−0.26	+0.25	−0.76	+6.1	+1.7
Sept. 1	Washington	ι Aquarii	I	−0.74	−0.13	−0.66	+0.21	−0.69	−0.17	+0.17	+0.38	−0.19	−2.9	+1.3
1	Washington	ι Aquarii	EB	+0.75	+0.13	−0.65	+0.20	−0.68	−0.10	−0.21	+0.35	+0.20	−0.4	−4.5
5	Cape	f Piscium	E	+0.68	+0.45	−0.26	+0.65	−0.70	−0.23	−0.29	−0.26	−0.35	+3.4	−0.3
9	Greenwich	α Tauri	IB	−0.30	+0.34	−0.44	−0.83	+0.94	+0.20	+0.09	+0.85	+0.34	−2.6	−0.9
9	Greenwich	α Tauri	E	+0.09	−0.10	−0.47	−0.88	+1.00	+0.18	0.00	+0.93	−0.10	−1.6	−2.1
9	Königsberg	75 Tauri	IB	−0.80	+0.90	−0.27	−0.55	−0.44	−0.04	+0.17	−0.46	+0.88	−5.0	−0.4
Oct. 8	Washington	64 Orionis	E	+0.89	−0.90	+0.07	+0.06	−0.09	−0.05	−0.07	−0.03	−0.96	+6.8	+1.9
11	Königsberg	θ Cancri	IB	−0.56	+0.51	+0.71	+0.05	−0.81	+0.11	−0.10	−0.70	+0.58	−5.0	−1.8
11	Königsberg	θ Cancri	E	+0.65	−0.58	+0.83	+0.06	−0.74	+0.13	+0.09	−0.56	−0.67	+5.6	+2.0
25	Kasan	114 B. Capricor.	I	−0.80	−0.38	−0.64	+0.08	−0.65	−0.22	+0.14	+0.41	−0.75	−2.9	+1.7
25	Kasan	ι Capricor.	I	−0.92	−0.44	−0.48	+0.08	−0.48	−0.20	+0.18	+0.27	−0.87	−2.9	+2.3
26	Königsberg	B.D.−14° 6228	I	−0.64	−0.21	+0.56	−0.22	+0.79	+0.13	+0.19	−0.47	−0.59	−2.4	+1.3
26	Königsberg	39 Aquarii	I	−0.70	−0.23	+0.49	−0.19	+0.74	+0.12	+0.21	−0.45	−0.65	−2.0	+2.0
26	Königsberg	B.D.−14° 6233	I	−1.01	−0.33	−0.47	+0.18	−0.24	−0.17	+0.26	+0.05	−0.92	−3.3	+2.5
28	Cape	27 Piscium	I	−0.70	−0.13	−0.45	+0.52	−0.69	−0.26	+0.21	+0.01	−0.51	−1.8	+2.2
Nov. 5	Greenwich	ν Geminor.	E	+0.89	−0.90	+0.13	+0.09	−0.16	−0.04	−0.05	−0.08	−0.79	+3.3	−1.6
19	Greenwich	o Sagittarii	I	−1.09	−0.91	+0.14	+0.06	+0.15	−0.17	−0.03	−0.27	−0.64	−6.1	+0.2
21	Washington	ι Capricor.	I	−0.51	−0.27	−0.85	+0.17	−0.87	−0.23	+0.09	+0.57	−0.47	−1.5	+1.4
22	Washington	45 Aquarii	I	−0.99	−0.32	−0.19	+0.09	−0.21	−0.14	+0.27	+0.02	−0.98	−4.2	+1.5
Dec. 5	Greenwich	X Cancri	E	+0.64	−0.34	−0.74	+0.07	+0.74	−0.11	+0.13	+0.62	−0.59	+3.7	+0.1
19	Cape	45 Capricor.	I	−0.70	−0.53	−0.02	−0.01	−0.02	−0.13	+0.25	−0.05	−0.72	−6.4	−2.3
25	Englehardt	ξ^2 Ceti	I	−0.70	+0.52	+0.02	+0.65	−0.65	−0.20	+0.21	−0.44	−0.67	−6.5	−2.4
25	Kasan	ξ^2 Ceti	I	−0.70	+0.53	+0.02	+0.64	−0.64	−0.20	+0.22	−0.44	−0.67	−4.9	−0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1907, Jan. 20	Königsberg	B.D.+3° 219	I	−0.95	+0.42	−0.04	+0.22	+0.14	+0.02	+0.36	−0.03	−0.97	−5.4	+0.1
26	Jena	ν Geminor.	I	−0.71	+0.78	−0.53	−0.28	+0.60	+0.05	+0.03	+0.54	−0.39	−5.3	−1.2
26	Greenwich	ν Geminor.	I	−0.81	+0.88	−0.37	−0.19	+0.42	+0.06	+0.05	+0.33	−0.45	−5.0	−0.3
27	Cape	63 Geminor.	I	−0.75	−0.67	+0.31	+0.07	−0.68	+0.14	−0.41	−0.63	−0.24	−5.5	−1.1
Feb. 1	Cape	ν Virginis	E	+0.95	+0.03	+0.17	−0.22	−0.28	+0.15	+0.32	+0.04	−0.73	+5.8	+0.3
16	Cape	f Piscium	I	−0.96	−0.25	−0.04	+0.19	−0.20	−0.12	+0.34	+0.02	−0.70	−4.3	+1.3
21	Cape	351 B. Tauri	I	−0.80	−0.86	−0.35	−0.31	+0.48	+0.08	+0.14	+0.40	−0.84	−5.5	−0.8
22	Washington	15 Geminor.	I	−0.65	+0.70	+0.63	+0.30	−0.70	+0.01	+0.03	−0.75	−0.58	−3.0	+0.8
22	Washington	16 Geminor.	I	−0.79	+0.85	−0.43	−0.21	+0.48	+0.08	+0.04	+0.40	−0.71	−5.3	−0.7
23	Greenwich	ζ Geminor.	I	−0.84	+0.88	+0.36	+0.11	−0.38	+0.03	−0.02	−0.43	−0.69	−4.8	+0.1
25	Königsberg	δ Cancri	I	−0.80	+0.62	+0.34	−0.03	−0.50	+0.09	−0.16	−0.44	−0.35	−2.5	+2.2
25	Cape	139 B. Cancri	I	−0.66	−0.52	−0.71	+0.10	+0.72	−0.13	−0.11	+0.51	−0.26	−5.3	−1.5
Mar. 10	Cape	19 Capricor.	E	+1.04	−0.82	+0.22	−0.03	+0.22	+0.17	−0.17	−0.16	−0.62	+6.2	+0.3
20	Greenwich	m Tauri	I	−0.65	+0.71	−0.50	−0.46	+0.68	+0.15	+0.14	+0.58	−0.72	−5.3	−1.5
21	Greenwich	χ^1 Orionis	I	−0.83	+0.93	+0.32	+0.20	−0.38	0.00	+0.07	−0.43	−0.93	−4.4	+0.5
21	Greenwich	χ^2 Orionis	I	−0.87	+0.98	−0.19	−0.11	+0.22	+0.06	+0.13	+0.09	−0.98	−6.8	−1.7
21	Jena	χ^1 Orionis	I	−0.82	+0.92	+0.33	+0.20	−0.39	+0.01	+0.08	−0.45	−0.92	−4.6	+0.2
21	Englehardt	B.D.+19° 1110	I	−0.69	+0.77	−0.54	−0.34	+0.64	+0.09	+0.08	+0.58	−0.77	−5.3	−1.2
22	Washington	ζ Geminor.	I	−0.85	+0.88	−0.33	−0.09	+0.34	+0.03	−0.02	+0.27	−0.89	−4.2	+0.8
24	Washington	δ Cancri	I	−0.82	+0.61	−0.47	+0.07	+0.47	−0.08	−0.15	+0.32	−0.63	−3.2	+1.6
24	Washington	δ Cancri	EB	+0.93	−0.68	−0.17	+0.03	+0.17	−0.02	+0.17	+0.21	+0.71	+2.7	−2.6
28	Greenwich	b Virginis	I	−0.67	−0.03	−0.39	+0.63	+0.74	−0.30	−0.19	−0.01	−0.04	−4.4	−0.4
Apr. 19	Greenwich	56 Geminor.	I	−0.77	+0.81	−0.52	−0.09	+0.53	−0.31	−0.34	+0.77	−0.85	−2.0	+2.5
25	Cape	c Virginis	I	−0.69	+0.05	−0.33	+0.67	+0.75	−0.34	−0.19	−0.08	−0.27	−4.6	−0.5
May 24	Greenwich	n Virginis	I	−0.39	−0.16	0.00	+0.93	+0.93	−0.38	−0.07	−0.43	−0.19	−2.4	−0.1
June 18	Cape	ν Virginis	I	−0.63	−0.14	−0.38	+0.65	+0.76	−0.29	−0.18	+0.08	−0.65	−6.4	−2.6
21	Jena	652 B. Virginis	I	−0.57	−0.28	−0.12	−0.83	−0.84	+0.22	−0.24	+0.41	−0.40	−4.0	−0.6
24	Greenwich	ξ Ophiuchi	I	−1.07	−0.92	−0.19	−0.13	−0.23	−0.14	−0.13	+0.19	−0.17	−7.1	−0.7
July 23	Kasan	ν^1 Sagittarii	I	−1.00	−0.04	+0.06	+0.02	+0.06	−0.07	0.00	−0.14	−0.29	−5.0	+1.0
23	Kasan	ν^2 Sagittarii	I	−0.99	−0.04	−0.17	−0.04	−0.17	−0.07	0.00	+0.09	−0.29	−5.6	+0.4
23	Cape	33 Sagittarii	I	−0.96	+0.83	−0.53	−0.12	−0.55	−0.18	−0.01	+0.54	−0.26	−5.0	+0.8
23	Cape	π Sagittarii	I	−1.01	+0.73	−0.46	−0.07	−0.47	−0.20	+0.02	+0.45	−0.22	−5.8	+0.3
26	Cape	39 Aquarii	E	+0.86	−0.72	+0.52	−0.38	+0.64	+0.32	−0.19	−0.27	−0.28	+5.9	+0.9
Aug. 18	Kasan	ξ Ophiuchi	I	−0.86	+0.29	−0.37	−0.23	−0.43	+0.04	−0.14	+0.35	−0.78	−7.3	−2.1
Sept. 14	Washington	ξ Ophiuchi	I	−0.76	−0.65	−0.62	−0.36	−0.71	−0.01	−0.12	+0.64	−0.71	−5.6	−1.0
15	Cape	30 G. Sagittarii	I	−1.03	+0.89	+0.29	+0.10	+0.32	−0.17	−0.07	−0.40	−0.93	−3.8	+2.5
16	Cape	o Sagittarii	I	−1.09	+0.99	+0.13	+0.02	+0.13	−0.17	+0.01	−0.12	−0.92	−5.0	+1.6
18	Englehardt	η Capricor.	EB	+0.26	+0.22	+0.90	−0.35	+0.97	+0.22	−0.03	−0.72	+0.17	−3.5	−5.0
19	Cape	39 Aquarii	I	−1.07	+0.81	+0.20	−0.15	+0.23	−0.10	+0.28	−0.21	−0.49	−6.1	+0.4
19	Cape	45 Aquarii	I	−1.10	+0.84	−0.07	+0.06	−0.10	−0.21	+0.28	−0.03	−0.51	−9.7	−3.0
24	Greenwich	μ Ceti	IB	−0.79	+0.21	−0.20	−0.55	+0.58	+0.16	+0.31	+0.29	+0.42	−8.2	−3.4
24	Greenwich	μ Ceti	E	+0.60	−0.16	−0.28	−0.73	+0.79	+0.28	−0.16	+0.57	−0.32	+3.7	+0.2
26	Greenwich	64 Tauri	IB	−0.78	+0.55	+0.39	+0.38	−0.54	−0.11	+0.18	−0.57	+0.70	−7.0	−2.2
Oct. 2	Greenwich	8 Leonis	E	+0.89	−0.84	+0.19	−0.11	−0.22	+0.03	+0.22	−0.07	−0.40	+7.3	+2.0
24	Greenwich	i Tauri	E	−0.88	−0.68	−0.21	−0.15	+0.26	+0.04	−0.19	+0.33	−0.57	+6.0	+0.8
24	Washington	333 B. Tauri	E	+0.91	−0.78	+0.17	+0.11	−0.20	−0.03	−0.18	−0.11	−0.67	+6.4	+1.0
24	Washington	107 Tauri	IB	−0.88	+0.76	−0.26	−0.16	+0.31	+0.05	+0.18	+0.22	+0.66	−7.8	−2.4
24	Washington	107 Tauri	E	+0.75	−0.65	−0.50	−0.30	+0.58	+0.09	−0.13	+0.63	−0.56	+4.7	+0.3
Nov. 16	Washington	117 G. Piscium	I	−0.38	−0.05	+0.09	+0.93	−0.93	−0.38	+0.07	−0.42	−0.23	−2.6	−0.3
Dec. 11	Washington	336 B. Aquarii	I	−0.41	−0.26	+0.39	−0.84	+0.92	+0.28	+0.20	−0.22	−0.39	−1.2	+1.3
11	Greenwich	290 B. Aquarii	I	−1.08	−0.77	+0.05	−0.09	+0.10	−0.13	+0.35	−0.11	−0.98	−4.1	+2.6
17	Greenwich	δ Tauri	I	−0.31	+0.17	−0.72	−0.59	+0.94	+0.22	+0.11	+0.82	−0.14	−2.5	−0.6
17	Greenwich	68 Tauri	I	−0.94	+0.52	+0.01	+0.01	−0.01	−0.02	+0.23	−0.09	−0.43	−4.9	+0.9
1908, Jan. 18	Washington	η Cancri	E	+0.89	−0.94	+0.10	−0.04	−0.11	−0.01	+0.15	0.00	−0.36	+8.3	+3.0
18	Washington	39 Cancri	E	+0.87	−0.92	+0.23	−0.10	−0.25	+0.01	+0.16	−0.11	−0.39	+3.3	−1.9
18	Washington	40 Cancri	E	+0.89	−0.94	+0.13	−0.06	−0.14	0.00	+0.16	−0.02	−0.40	+8.2	+2.9
29	Washington	21 G. Sagittarii	E	+1.06	+0.83	−0.22	−0.06	−0.23	+0.18	+0.09	+0.31	−0.54	+6.8	+0.4
Mar. 7	Washington	30 B. Tauri	I	−0.92	+0.17	+0.23	+0.24	−0.34	−0.15	+0.26	−0.36	−0.84	−4.8	+1.0
10	Washington	η Geminor.	I	−0.45	+0.37	+0.86	+0.12	−0.87	−0.06	+0.04	−0.91	−0.49	−2.0	+0.8
10	Washington	η Geminor.	EB	+0.52	−0.43	+0.82	+0.12	−0.83	−0.05	−0.04	−0.78	+0.55	+4.1	+0.9
13	Greenwich	39 Cancri	I	−0.86	+0.97	−0.24	+0.10	+0.26	−0.01	−0.15	+0.12	−0.70	−6.6	−1.2
13	Greenwich	40 Cancri	I	−0.86	+0.92	−0.35	+0.16	+0.39	−0.03	−0.14	+0.24	−0.66	−5.8	−0.7
13	Greenwich	116 B. Ophiuchi	E	+0.85	+0.54	−0.57	−0.25	−0.62	+0.23	+0.13	+0.67	−0.77	+3.8	−1.4
Apr. 6	Washington	141 Tauri	I	−0.58	+0.44	+0.78	+0.13	−0.78	−0.07	−0.05	−0.83	−0.59	−3.2	+0.5
9	Washington	39 Cancri	I	−0.48	+0.54	−0.75	+0.39	+0.84	−0.12	−0.08	+0.62	−0.51	−3.8	−0.8
9	Washington	40 Cancri	I	−0.34	+0.38	−0.82	+0.42	+0.92	−0.14	−0.06	+0.70	−0.87	−5.3	−3.1
13	Washington	ν Virginis	I	−0.92	+0.72	+0.01	−0.05	−0.05	+0.02	−0.38	−0.09	−0.45	−7.7	−1.9
June 11	Washington	o Libræ	I	−1.01	−0.16	+0.11	+0.11	+0.15	−0.14	−0.29	−0.19	−0.41	−7.7	−1.3
15	Washington	49 Sagittarii	E	+1.01	+0.81	−0.39	+0.09	−0.40	+0.15	−0.04	+0.47	−0.39	+3.9	−2.3
16	Washington	36 B. Capricor.	IB	−1.04	−0.90	−0.29	+0.15	−0.33	−0.22	+0.14	+0.20	+0.56	−5.9	+0.7

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1908, June 16	Washington	36 B. Capricor.	E	+1.09	+0.94	−0.19	+0.10	−0.21	+0.16	−0.15	+0.27	−0.59	+5.1	−1.6
17	Washington	30 Piscium	IB	−0.04	+0.01	−0.13	+0.99	−1.00	−0.39	−0.06	+0.05	+0.03	−0.2	0.0
17	Washington	30 Piscium	E	+0.31	−0.07	−0.12	+0.94	−0.95	−0.33	−0.20	+0.08	−0.82	+0.5	−1.4
Aug. 3	Washington	88 Virginis	I	−0.94	+0.35	−0.08	−0.19	−0.21	+0.04	−0.38	+0.01	−0.97	−7.0	−1.0
9	Washington	49 Sagittarii	I	−0.86	−0.66	−0.58	+0.18	−0.61	−0.16	+0.04	+0.50	−0.36	−5.2	+0.3
10	Washington	36 B. Capricor.	I	−1.02	−0.87	−0.31	+0.18	−0.36	−0.21	+0.14	+0.22	−0.24	−6.6	−0.1

SECTION II.—MEAN LONGITUDES FOR THE PERIOD 1753–1908.

45. The corrections λ for this period have been formed on the plan described in §39. The irregular character of the observations before 1810 or 1820 prevents their being treated on a strictly uniform system. Owing to the probability of systematic differences between the results of immersions and emersions which may arise from the errors both of the semidiameter and of the parallactic equation, the mean values from the two phases should be derived separately and compared. This is easy during the last half century, when the observations were numerous. But before that time the mean epoch of the groups of the two phases does not coincide, so that a strict comparison can not be made between the two classes of results.

The length of time embraced in a single group is also quite irregular. As to the length of the groups, the general rule is that observations through any period during which the correction $\delta\lambda$ may be assumed to vary uniformly with the time may be combined into one group. But we can not determine how long this may be. The fluctuations appear sometimes to be remarkably rapid. The best that we can do is to limit the lengths of the periods to times in which the probable variation of the fluctuations will be less than the probable error of the mean result.

After 1845 the observations are so much more numerous that the results for each year are commonly combined in a separate group.

Group Corrections to the Moon's Mean Longitude.

PERIOD 1753–1845.

Immersions.				Emersions.				
Epoch.	[aa]	[an]	λ	Epoch.	[aa]	[an]	λ	I−E
		″	″			″	″	″
1755.7	4.8	− 5.2	−1.08	......	....	......	......	......
1771.4	15.2	−12.4	−0.82	1771.8	11.3	+14.0	+1.24	−2.06
1785.0	10.1	+ 2.6	+0.26	......	....	......	......	......
1792.0	11.7	−14.0	−1.20	1790.0	10.7	− 4.7	−0.44	−0.76
1801.9	17.5	−31.8	−1.81	1801.7	10.2	−17.2	−1.68	−0.13
1810.4	23.1	−23.7	−1.03	1810.4	7.8	−18.2	−2.34	+1.31
1813.3	25.4	−61.6	−2.42	1813.2	6.4	−11.0	−1.72	−0.70
1821.0	13.4	−11.7	−0.88	1821.6	18.5	− 2.2	−0.12	−0.76
1822.9	8.3	− 1.2	−0.15	1822.8	7.1	+21.2	+2.99	−3.14
1826.0	20.5	− 6.9	−0.34	1826.2	8.1	+11.2	+1.38	−1.72
1830.6	52.5	−92.0	−1.75	1830.8	15.2	−38.0	−2.50	+0.75
1834.5	34.5	−66.8	−1.94	1834.5	3.1	− 3.1	−1.00	−0.94
1839.3	50.8	−47.2	−0.93	1839.6	14.9	− 2.5	−0.18	−0.75
1843.6	37.1	+31.5	+0.85	1843.1	12.3	+28.9	+2.35	−1.50

Group Corrections to the Moon's Mean Longitude—Continued.

PERIOD 1846–1908.

[The means are mostly taken for single years.]

Year.	Immersions.			Emersions.			I−E	Final λ	Wt.
	[aa]	[an]	λ	[aa]	[an]	λ			
		"	"		"	"	"	"	
1847.0	16.0	+ 18.8	+1.18	5.9	+ 11.7	+2.00	−0.82	+1.40	22
1848.5	9.6	+ 26.7	+2.79	5.2	+ 10.4	+2.00	+0.79	+2.51	15
1849.5	22.8	+ 11.2	+0.50	7.8	+ 11.4	+1.47	−0.97	+0.75	31
1850.5	26.5	+ 45.4	+1.72	11.1	+ 18.0	+1.62	+0.10	+1.69	38
1851.5	18.0	+ 30.4	+1.69	4.6	+ 6.4	+1.40	+0.29	+1.63	23
1852.5	11.9	+ 22.1	+1.86	2.3	+ 1.1	+0.48	+1.38	+1.64	14
1853.5	9.8	+ 19.5	+2.00	5.4	+ 7.0	+1.30	+0.70	+1.75	15
1854.5	22.5	+ 58.9	+2.62	7.5	+ 17.5	+2.30	+0.32	+2.54	30
1855.5	6.6	+ 23.8	+3.60	5.1	+ 14.6	+2.86	+0.74	+3.28	12
1856.5	7.0	+ 19.3	+2.76	1.0	+ 5.5	+5.50	−2.74	+3.11	8
1857.5	11.4	+ 45.2	+3.97	4.4	+ 9.0	+2.04	+1.93	+3.43	16
1858.5	8.3	+ 31.9	+3.85	6.7	+ 38.8	+5.80	−1.95	+4.72	15
1859.5	9.2	+ 47.1	+5.12	3.0	+ 18.5	+6.18	−1.06	+5.38	12
1860.5	16.9	+ 95.9	+5.68	8.8	+ 41.8	+4.77	+0.91	+5.37	26
1861.5	7.0	+ 32.2	+4.60	3.5	+ 18.2	+5.20	−0.60	+4.80	11
1862.5	7.2	+ 38.2	+5.31	7.2	+ 39.7	+5.52	−0.21	+5.42	14
1863.5	17.6	+ 73.6	+4.18	9.3	+ 50.2	+5.40	−1.22	+4.60	27
1864.5	12.6	+ 62.2	+4.94	8.1	+ 31.4	+3.90	+1.04	+4.53	21
1865.5	7.2	+ 37.5	+5.21	2.6	+ 5.5	+2.13	+3.08	+4.39	10
1866.5	4.4	+ 19.1	+4.33	8.4	+ 38.3	+4.56	−0.23	+4.48	13
1867.5	7.8	+ 22.2	+2.85	2.2	+ 0.9	+0.41	+2.44	+2.32	10
1868.5	17.0	+ 48.5	+2.85	4.9	+ 10.6	+2.16	+0.69	+2.69	22
1869.5	12.8	+ 39.2	+3.06	3.8	+ 16.9	+4.45	−1.39	+3.38	17
1870.5	8.8	+ 21.0	+2.39	2.8	+ 7.5	+2.68	−0.29	+2.46	12
1871.5	15.5	+ 11.8	+0.76	4.3	+ 0.2	+0.05	+0.71	+0.50	20
1872.5	16.7	+ 9.5	+0.57	6.6	− 2.4	−0.36	+0.93	+0.31	23
1873.5	20.8	+ 10.0	+0.48	8.9	+ 0.3	+0.03	+0.45	+0.35	30
1874.5	11.8	+ 10.1	+0.86	3.1	− 10.2	−3.29	+4.15	0.00	15
1875.5	13.0	+ 8.6	+0.66	3.4	− 8.0	−2.35	+3.01	+0.04	16
1876.5	35.7	+ 9.3	+0.26	27.2	+ 2.7	+0.10	+0.16	+0.19	63
1878.0	17.8	+ 16.7	+0.94	21.5	+ 6.4	+0.30	+0.64	+0.59	40
1879.5	13.4	+ 17.4	+1.30	12.8	+ 32.3	+2.53	−1.23	+1.90	26
1880.5	29.2	+ 37.4	+1.28	13.5	+ 9.1	+0.68	+0.60	+1.09	43
1881.5	15.6	+ 14.5	+0.93	4.0	+ 7.7	+1.92	−0.99	+1.13	20
1882.5	7.3	+ 9.7	+1.33	9.5	+ 10.5	+1.11	+0.22	+1.21	17
1883.5	13.1	+ 12.6	+0.96	3.5	− 4.2	−1.20	+2.16	+0.50	17
1884.5	31.7	+ 18.1	+0.57	28.0	+ 22.2	+0.79	−0.22	+0.67	60
1885.5	148.4	+ 75.9	+0.51	36.9	+ 0.8	+0.02	+0.49	+0.41	185
1886.5	26.5	+ 7.7	+0.29	8.2	+ 0.8	+0.10	+0.19	+0.25	35
1887.5	30.4	+ 24.5	+0.81	16.5	− 10.1	−0.61	+1.42	+0.31	47
1888.5	11.0	− 4.2	−0.38	5.5	− 2.8	−0.51	+0.13	−0.42	17
1889.5	10.4	+ 5.1	+0.49	3.7	− 10.5	−2.84	+3.33	−0.38	14
1890.5	9.2	− 3.5	−0.38	14.6	− 3.5	−0.24	−0.14	−0.29	24
1891.5	19.6	+ 2.1	+0.11	9.6	− 1.6	−0.17	+0.28	+0.02	29
1892.5	18.6	+ 23.9	+1.29	10.7	− 10.9	−1.02	+2.31	+0.45	29
1893.5	16.0	+ 18.5	+1.16	9.1	− 5.3	−0.58	+1.74	+0.53	25
1894.5	40.3	+ 27.2	+0.68	18.1	− 4.7	−0.26	+0.94	+0.39	58
1895.5	142.7	+174.0	+1.22	74.5	+112.8	+1.52	−0.30	+1.32	217
1896.5	134.0	+326.5	+2.44	70.3	+148.8	+2.12	+0.32	+2.33	204
1897.5	24.6	+ 43.6	+1.77	8.2	+ 13.4	+1.64	+0.13	+1.74	33
1898.5	30.7	+ 60.6	+1.98	13.8	+ 42.1	+3.05	−1.07	+2.31	44
1899.5	15.3	+ 34.4	+2.25	9.9	+ 25.7	+2.60	−0.35	+2.39	25
1900.5	26.7	+ 99.3	+3.72	10.0	+ 37.8	+3.78	−0.06	+3.74	37
1901.5	23.7	+ 84.6	+3.57	13.9	+ 53.8	+3.87	−0.30	+3.68	38
1902.5	26.6	+114.7	+4.31	12.9	+ 52.7	+4.09	+0.22	+4.24	40
1903.5	17.5	+ 83.0	+4.74	7.1	+ 29.5	+4.15	+0.59	+4.57	25
1904.5	29.7	+146.2	+4.92	15.4	+ 82.1	+5.33	−0.41	+5.06	45
1905.5	29.0	+158.7	+5.47	10.3	+ 62.1	+6.03	−0.56	+5.62	39
1906.5	16.9	+ 96.7	+5.73	13.6	+ 66.1	+4.86	+0.87	+5.34	31
1907.5	17.3	+104.0	+6.04	4.1	+ 26.3	+6.40	−0.36	+6.11	21
1908.3	6.1	+ 37.9	+6.17	5.7	+ 34.3	+6.05	+0.12	+6.11	12

46. The differences between the results of the two phases are, in the general average, markedly larger than would be the values derived from the probable errors. Yet the systematic difference seems to be small, and perhaps variable, so that it might have been ignored without seriously changing any of the results. The following method of combination has been adopted as likely to lead to the best results.

To find the corrections to the mean longitude itself, the results of the two phases have been reduced to a common mean standard by applying the following reductions:

1753–1847	$\delta\lambda$ (im.) $= +0''.2$	$\delta\lambda$ (em.) $= -0''.2$
1848–1873	$\delta\lambda$ (im.) $= -0.07$	$\delta\lambda$ (em.) $= +0.07$
1874–1899	$\delta\lambda$ (im.) $= -0.20$	$\delta\lambda$ (em.) $= +0.20$
1900–1908	$\delta\lambda$ (im.) $= 0.00$	$\delta\lambda$ (em.) $= 0.00$

These mean results have been combined and smoothed off to obtain the varying correction to the mean longitude itself. The result is given in the column, "General λ" in the table immediately following.

But, in the final solution of the equations for the other unknown quantities the values of λ to be used as given quantities should be affected by their systematic errors, whatever these may be. The preceding corrections have therefore been subtracted from the smoothed off general values to obtain those to be used for the two phases separately. The results are shown in the following table:

Observed Corrections to the Moon's Mean Longitude.

Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ
	″	″	″		″	″	″		″	″	″
1670.0	−1.3	...	...	1705.0	+0.2	...	...	1740.0	−0.7	...	...
1671.0	1.3	...	...	1706.0	0.2	...	...	1741.0	0.7	...	...
1672.0	1.3	...	...	1707.0	0.2	...	...	1742.0	0.7	...	...
1673.0	1.3	...	...	1708.0	0.3	...	...	1743.0	0.8	...	...
1674.0	1.3	...	...	1709.0	0.3	...	...	1744.0	0.8	...	...
1675.0	−1.3	...	...	1710.0	+0.3	...	...	1745.0	−0.8	...	...
1676.0	1.3	...	...	1711.0	0.3	...	...	1746.0	0.9	...	...
1677.0	1.3	...	...	1712.0	0.3	...	...	1747.0	0.9	...	...
1678.0	1.3	...	...	1713.0	0.3	...	...	1748.0	0.9	...	...
1679.0	1.3	...	...	1714.0	0.3	...	...	1749.0	0.9	...	...
1680.0	−1.3	...	...	1715.0	+0.3	...	...	1750.0	−0.8	−1.0	−0.6
1681.0	1.3	...	...	1716.0	0.3	...	...	1751.0	0.8	1.0	0.6
1682.0	1.2	...	...	1717.0	0.2	...	...	1752.0	0.8	1.0	0.6
1683.0	1.1	...	...	1718.0	0.2	...	...	1753.0	0.8	1.0	0.6
1684.0	1.0	...	...	1719.0	0.2	...	...	1754.0	0.8	1.0	0.6
1685.0	−0.9	...	...	1720.0	+0.1	...	...	1755.0	−0.8	−1.0	−0.6
1686.0	0.9	...	...	1721.0	0.1	...	...	1756.0	0.7	0.9	0.5
1687.0	0.8	...	...	1722.0	+0.1	...	...	1757.0	0.7	0.9	0.5
1688.0	0.7	...	...	1723.0	0.0	...	...	1758.0	0.7	0.9	0.5
1689.0	0.6	...	...	1724.0	0.0	...	...	1759.0	0.7	0.9	0.5
1690.0	−0.5	...	...	1725.0	−0.1	...	...	1760.0	−0.7	−0.9	−0.5
1691.0	0.5	...	...	1726.0	0.1	...	...	1761.0	0.7	0.9	0.5
1692.0	0.4	...	...	1727.0	0.2	...	...	1762.0	0.6	0.8	0.4
1693.0	0.3	...	...	1728.0	0.2	...	...	1763.0	0.6	0.8	0.4
1694.0	0.2	...	...	1729.0	0.3	...	...	1764.0	0.5	0.7	0.3
1695.0	−0.2	...	...	1730.0	−0.3	...	...	1765.0	−0.5	−0.7	−0.3
1696.0	0.1	...	...	1731.0	0.4	...	...	1766.0	0.4	0.6	0.2
1697.0	−0.1	...	...	1732.0	0.4	...	...	1767.0	0.3	0.5	0.1
1698.0	0.0	...	...	1733.0	0.5	...	...	1768.0	0.3	0.5	−0.1
1699.0	0.0	...	...	1734.0	0.5	...	...	1769.0	0.2	0.4	0.0
1700.0	+0.1	...	...	1735.0	−0.5	...	...	1770.0	−0.1	−0.3	+0.1
1701.0	0.1	...	...	1736.0	0.6	...	...	1771.0	0.0	0.2	0.2
1702.0	0.1	...	...	1737.0	0.6	...	...	1772.0	+0.1	−0.1	0.3
1703.0	0.2	...	...	1738.0	0.6	...	...	1773.0	0.2	0.0	0.4
1704.0	0.2	...	...	1739.0	0.6	...	...	1774.0	0.3	+0.1	0.5

Observed Corrections to the Moon's Mean Longitude—Continued.

Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ
	″	″	″		″	″	″		″	″	″
1775.0	+0.3	+0.1	+0.5	1820.0	−1.7	−1.9	−1.5	1865.0	+4.6	+4.7	+4.5
1776.0	0.4	0.2	0.6	1821.0	1.7	1.9	1.5	1866.0	4.2	4.3	4.1
1777.0	0.4	0.2	0.6	1822.0	1.7	1.9	1.5	1867.0	3.8	3.9	3.7
1778.0	0.4	0.2	0.6	1823.0	1.6	1.8	1.4	1868.0	3.3	3.4	3.2
1779.0	0.4	0.2	0.6	1824.0	1.6	1.8	1.4	1869.0	2.8	2.9	2.7
1780.0	+0.4	+0.2	+0.6	1825.0	−1.6	−1.8	−1.4	1870.0	+2.2	+2.3	+2.1
1781.0	0.4	0.2	0.6	1826.0	1.6	1.8	1.4	1871.0	1.5	1.6	1.4
1782.0	0.4	0.2	0.6	1827.0	1.5	1.7	1.3	1872.0	0.8	0.9	0.7
1783.0	0.3	0.1	0.5	1828.0	1.5	1.7	1.3	1873.0	+0.2	0.3	+0.1
1784.0	0.3	+0.1	0.5	1829.0	1.4	1.6	1.2	1874.0	0.0	0.2	−0.2
1785.0	+0.2	0.0	+0.4	1830.0	−1.3	−1.5	−1.1	1875.0	0.0	+0.2	−0.2
1786.0	0.2	0.0	0.4	1831.0	1.2	1.4	1.0	1876.0	+0.1	0.3	−0.1
1787.0	+0.1	−0.1	0.3	1832.0	1.1	1.3	0.9	1877.0	0.4	0.6	+0.2
1788.0	0.0	0.2	0.2	1833.0	1.0	1.2	0.8	1878.0	0.8	1.0	0.6
1789.0	−0.1	0.3	+0.1	1834.0	0.9	1.1	0.7	1879.0	1.1	1.3	0.9
1790.0	−0.3	−0.5	−0.1	1835.0	−0.8	−1.0	−0.6	1880.0	+1.2	+1.4	+1.0
1791.0	0.4	0.6	0.2	1836.0	0.7	0.9	0.5	1881.0	1.2	1.4	1.0
1792.0	0.5	0.7	0.3	1837.0	0.6	0.8	0.4	1882.0	1.1	1.3	0.9
1793.0	0.7	0.9	0.5	1838.0	0.5	0.7	0.3	1883.0	0.9	1.1	0.7
1794.0	0.8	1.0	0.6	1839.0	0.4	0.6	0.2	1884.0	0.7	0.9	0.5
1795.0	−1.0	−1.2	−0.8	1840.0	−0.3	−0.5	−0.1	1885.0	+0.5	+0.7	+0.3
1796.0	1.1	1.3	0.9	1841.0	−0.1	0.3	+0.1	1886.0	+0.2	0.4	0.0
1797.0	1.2	1.4	1.0	1842.0	0.0	−0.2	0.2	1887.0	0.0	+0.2	−0.2
1798.0	1.3	1.5	1.1	1843.0	+0.2	0.0	0.4	1888.0	−0.2	0.0	0.4
1799.0	1.4	1.6	1.2	1844.0	0.3	+0.1	0.5	1889.0	0.3	−0.1	0.5
1800.0	−1.5	−1.7	−1.3	1845.0	+0.5	+0.3	+0.7	1890.0	−0.3	−0.1	−0.5
1801.0	1.5	1.7	1.3	1846.0	0.6	0.5	0.8	1891.0	0.3	−0.1	0.5
1802.0	1.6	1.8	1.4	1847.0	0.8	0.7	0.9	1892.0	−0.1	+0.1	−0.3
1803.0	1.6	1.8	1.4	1848.0	0.9	1.0	0.9	1893.0	+0.2	0.4	0.0
1804.0	1.6	1.8	1.4	1849.0	1.1	1.2	1.0	1894.0	0.6	0.8	+0.4
1805.0	−1.6	−1.8	−1.4	1850.0	+1.2	+1.3	+1.1	1895.0	+1.1	+1.3	+0.9
1806.0	1.6	1.8	1.4	1851.0	1.4	1.5	1.3	1896.0	1.5	1.7	1.3
1807.0	1.6	1.8	1.4	1852.0	1.5	1.6	1.4	1897.0	1.9	2.1	1.7
1808.0	1.6	1.8	1.4	1853.0	1.7	1.8	1.6	1898.0	2.3	2.5	2.1
1809.0	1.7	1.9	1.5	1854.0	2.0	2.1	1.9	1899.0	2.7	2.8	2.6
1810.0	−1.7	−1.9	−1.5	1855.0	+2.4	+2.5	+2.3	1900.0	+3.2	+3.2	+3.2
1811.0	1.7	1.9	1.5	1856.0	3.0	3.1	2.9	1901.0	3.6	3.6	3.6
1812.0	1.7	1.9	1.5	1857.0	3.7	3.8	3.6	1902.0	4.1	4.1	4.1
1813.0	1.7	1.9	1.5	1858.0	4.4	4.5	4.3	1903.0	4.4	4.4	4.4
1814.0	1.7	1.9	1.5	1859.0	4.8	4.9	4.7	1904.0	4.8	4.8	4.8
1815.0	−1.7	−1.9	−1.5	1860.0	+5.1	+5.2	+5.0	1905.0	+5.1	+5.1	+5.1
1816.0	1.7	1.9	1.5	1861.0	5.2	5.3	5.1	1906.0	5.5	5.5	5.5
1817.0	1.7	1.9	1.5	1862.0	5.2	5.3	5.1	1907.0	5.8	5.8	5.8
1818.0	1.7	1.9	1.5	1863.0	5.1	5.2	5.0	1908.0	6.1	6.1	6.1
1819.0	1.7	1.9	1.5	1864.0	4.9	5.0	4.8	1909.0	+(6.4)	+(6.4)	+(6.4)

SECTION III.—ELEMENTS OF THE MOON'S MEAN LONGITUDE.

The preceding corrections in mean longitude apply to the provisional theory constructed in Chapter III, which contains an empirical term, and is otherwise not a rigorous expression of the results of gravitational theory. Since the results of observation should be compared with a pure theory, our first step is to construct the latter.

47. *Ulterior corrections to the secular variations.*—This subject, strictly speaking, belongs to Chapter III, because it discusses the corrections to some of Hansen's elements. It comprises theoretical corrections which so slightly affect modern positions of the moon that they have been ignored in discussing those positions. Brown's researches have shown that the motion of the moon's perigee and node agree with gravitational theory within the limits of probable error of the theory and of the observations. Such being the case, we are justified in regarding this agreement as a permanent feature of the lunar theory. It follows that, were the theoretical computations of the motion complete, and all the elements on which it depends precisely known, we might pro-

visionally adopt the motions of these two elements given by the theory. But a summation of Brown's results, as given in Chapter IX of his work,[a] shows that the effect of the terms of the sixth order in e and γ, which he has omitted, may be to change the theoretical motion by a few seconds per century. The uncertainty of the effect arising from the earth's ellipticity is yet larger, and it is also possible that some slight change may be caused by the ellipticity of the moon itself.

It follows that the motions of the perigee and node to be finally adopted must still be derived from observation. But the agreement of the observed motions with theory is so close that we are fully justified in determining the acceleration of the motion from the secular change of the elements on which the motions depend; that is to say, to the theoretical motion we may add a minute constant to represent observations without changing the theoretical secular acceleration.

Hansen's accelerations of the perigee and node have been adopted without change in all our work up to the present stage. It now becomes advisable, in the final comparison, to make any corrections that may be necessary. Brown's final results enable this to be done with ease and certainty.

Fundamentally, the only variable element on which the motions depend is the eccentricity of the earth's orbit. The inclination and eccentricity of the moon's orbit change so slightly that they may be regarded as absolute constants during all history.

The secular acceleration of the moon's mean longitude has been determined both by Brown and the writer with results practically identical when reduced to the same values of the elements. We have now only to consider those of the perigee and node. We express the longitudes of these elements in the general form

$$\pi=\pi_0+\pi_1\mathrm{T}+\pi_2\mathrm{T}^2+\pi_3\mathrm{T}^3.$$

Brown[b] has expressed π_1 and θ_1 in the form

$$\pi_1;\ \theta_1=\varphi\ (e', n),$$

in which the constant elements need not be written. Here n is the actually observed mean motion of the moon, which changes slightly through the change of e'. The variation may be expressed in the form

$$D_t n=ke'D_t e'=\tfrac{1}{2}kD_t\eta,$$

where k is a function of n and of the other elements, which we may regard as constant, and where we put for brevity

$$\eta=e'^2.$$

Brown's expressions of π_1 and θ_1 may, by summation of similar terms, be expressed in the form

$$\pi_1=\pi_1^0+h\eta,$$
$$\theta_1=\theta_1^0+h'\eta.$$

in which the second terms are much smaller than the first.

The derivative of π_1 as to the time may be written

$$D_t\pi_1=hD_t\eta+\frac{d\pi_1}{dn}D_t n$$

with a similar expression for the motion of the node, using h' for h.

[a] Theory of the Motion of the Moon, Memoirs of the Royal Ast. Soc., Vol. LVII.
[b] Memoirs of the Royal Ast. Soc., Vol. LVII, p. 110.

From Brown's numerical values we find by summation, and reducing to the century as the unit of time,

$$h\eta = 15367'',$$
$$h'\eta = -2595''.$$

the epoch being 1850. Dividing by Brown's adopted e'^2 for 1850, we find

$$10^{-6}h = 54''.64,$$
$$10^{-6}h' = -9''.23.$$

From the author's Tables of the Sun, page 9, for 1900,

$$e' = .01675104 - .00004180\ \mathrm{T} - .000000126\ \mathrm{T}^2,$$

whence

$$10^6\eta = 280.60 - 1.4004\ \mathrm{T} - .00248\ \mathrm{T}^2.$$

From these numbers the secular accelerations arising directly from the change of η, terms in T^3 being dropped, are

$$\varDelta\pi_1 = h\eta = -76''.52\ \mathrm{T} - 0''.1355\ \mathrm{T}^2,$$
$$\varDelta\theta_1 = h'\eta = +12''.92\ \mathrm{T} + 0''.0229\ \mathrm{T}^2,$$

where T is reckoned from 1900.

We have still to derive that part of the variation arising from n. I have found from Delaunay's expressions[a]

$$\frac{d\pi_1}{dn} = -.01480,$$
$$\frac{d\theta_1}{dn} = +.00377.$$

The secular acceleration of n is, from Brown and myself, including the effect of the earth's oblateness,

$$D_t n = 12''.34 + 0''.0408\ \mathrm{T},$$

which gives

$$D_t\pi_1 = -0''.183 - 0''.00060\ \mathrm{T},$$
$$D_t\theta_1 = +0''.046 + 0''.00016\ \mathrm{T},$$
$$\varDelta\pi_1 = -0''.183\ \mathrm{T} - 0''.0003\ \mathrm{T}^2,$$
$$\varDelta\theta_1 = +0''.046\ \mathrm{T}.$$

Adding these terms to the principal term above we have for the complete values of the secular accelerations

$$\varDelta\pi_1 = -76''.70\ \mathrm{T} - 0''.1358\ \mathrm{T}^2,$$
$$\varDelta\theta_1 = +12''.97\ \mathrm{T} + 0''.0229\ \mathrm{T}^2.$$

Integrating these, the complete expressions for π and θ become

$$\pi = \pi_0 + \pi_1\ \mathrm{T} - 38''.35\ \mathrm{T}^2 - 0''.0453\ \mathrm{T}^3,$$
$$\theta = \theta_0 + \theta_1\ \mathrm{T} + 6''.48\ \mathrm{T}^2 + 0''.0076\ \mathrm{T}^3,$$

where the first two terms of each are to be determined from observation.

The above expressions are referred to a fixed departure point. To reduce them to the mean equinox of any date we have to apply a further correction for precession. This may be found from the data given in the author's Compendium of Spherical Astronomy, Chapter IX, section 126.

[a] "Action II," section 27, p. 33.

Repeating the computation there made for other epochs, I have found the following values of the instantaneous centennial planetary and luni-solar precessions in longitude, p, and λ,

Epoch.	p	λ	l
	$''$	$''$	$''$
−150	5027.03	−46.38	4980.65
−100	5027.29	−45.55	4981.74
+850	5031.89	−29.52	5002.37
900	5032.13	−28.71	5003.42
1850	5036.84	−12.31	5024.53
1900	5037.08	−11.45	5025.64

These numbers give for the centennial motion of precession in longitude, using the epoch 1900,

$$l=5025''.64+2''.23\ T+0''.0026\ T^2.$$

The entire correction of π and θ for precession in longitude thus becomes

$$\text{Prec.}=5025''.64\ T+1''.11\ T^2+0''.00087\ T^3.$$

The motions from the mean equinox now take the form

$$\pi=\pi_0+\pi_1\ T-37''.24\ T^2-0''.0444\ T^3,$$
$$\theta=\theta_0+\theta_1\ T+\ 7''.59\ T^2+0''.0085\ T^3.$$

To compare these with Hansen, we should transfer the epoch for $T=0$ from 1900 to 1800. Thus for the secular accelerations

$$\Delta\pi=-37''.10\ T^2-0''.0444\ T^3,$$
$$\Delta\theta=+\ 7''.56\ T^2+0''.0085\ T^3.$$

Hansen's values, which are those of the provisional theory, are

$$\Delta\pi=-36''.134\ T^2-0''.0366\ T^3,$$
$$\Delta\theta=+\ 8''.189\ T^2+0''.00716\ T^3.$$

The corrections required are

$$\Delta\pi=-0''.97\ T^2-0''.0078\ T^3,$$
$$\Delta\theta=-0''.63\ T^2+0''.0013\ T^3,$$

where T is reckoned from 1800.

The terms in T^3 are practically unimportant. Those in T^2 should, however, be taken account of in the modern observations at least. It does not seem that any secular corrections should be applied to the provisional mean longitude. The coefficient of T^2 in this element is to be determined from observation.

Omitting the unknown tidal retardation from the theory, the secular terms of the mean longitude referred to a fixed equinox are

$$\Delta\lambda=5''.80\ T^2+0''.0068\ T^3.$$

There is also a term in T^2 arising from the increasing effect of the earth's ellipticity, brought about by the diminution in the obliquity of the ecliptic. This term, of which the principal part was first computed by Stockwell, I estimated at $0''.27\ T^2$. We have also to add in the precession,

of which the value has just been given. The sum of the three expressions gives, for the secular terms referred to the mean equinox

$$\Delta\lambda = 7''.18\ T^2 + 0''.0077\ T^3.$$

Hansen's terms are

$$\Delta(g+\omega-\theta) = 13''.30\ T^2 + 0''.01347\ T^3.$$

Thus the entire theoretical correction to his mean longitude may be written

$$\Delta\lambda = a + b\ T - 6''.12\ T^2 - 0''.0058\ T^3.$$

The correction we have used in the provisional theory is

$$\Delta\lambda = -3''.76\ T^2,$$

which is tantamount to allowing the term $2''.36\ T^2$ for the tidal retardation. This we retain for the final comparison. The term of precession in T^3 should be applied also to the longitudes of the sun and stars. As this has not been done, we should omit the precessional term in T^3 from the moon's longitude. Doing this the correction to Hansen will be

$$\Delta\lambda = -0''.0067\ T^3.$$

It is a serious question whether the term of the precession in T^3, of which the coefficient is $0''.0009$, should be included for any purpose at the present time. It is of course necessary if all our longitudes are to be referred to the absolute equinox. But, practically, the term in question has been omitted in all our astronomical work, and it will not reach the value of $0''.10$ within 1,000 years before or after the present time.

Reduction of the Provisional Mean Longitude to Pure Theory.

48. To draw the clearest conclusion from the observed corrections of λ already found, we have to recapitulate the main points of the theory of comparison, especially the parts of which it is formed. These are the following:

1. We have as the basis of the whole work the longitudes of the moon as derived from Hansen's Tables de la Lune, without any change whatever except that arising from the correction of one of the tables. On the longitudes thus derived is based the ephemeris of comparison used throughout the Researches of 1878, and the ephemerides of the British Nautical Almanac from 1862 to 1882, inclusive. I shall designate this system of tabular longitudes by the symbol H.

2. The right ascensions and declinations of the Nautical Almanac, and all the coordinates, both ecliptic and equatorial, of the American Ephemeris from 1883 to the present time, are based on H, with the addition of secular and long-period corrections of two classes. The first and principal class comprises corrections to the elements of mean longitude, and the omission of Hansen's purely empirical term $21''.47 \sin(8V - 13E + 274° 14')$, which I call V_2, and which has no existence in the theory. The second class comprises the single empirical term $-15''.5 \cos A$, which has never been found in the theory and which may be regarded as a substitute for Hansen's empirical term. The entire expression for the sum of these corrections has been given in Chapter III, Equation 20, and is tabulated on page 30 for every tenth year of the modern period.

Possible confusion may be avoided by distinguishing between two ways of applying this correction. When a longitude of the moon has been derived from H unchanged, the tabular correction is applicable to it. But if a corrected ephemeris is to be computed from the tables, it is more convenient to omit Table XLI of H, which contains the empirical term to be dropped plus the constant $21''.49$. Since the negative of this term is included in the table on page 30 only for the purpose

of annulling it, the practical correction to be applied in this case will be the table on page 30 minus Hansen's Table XLI. Then, instead of the correction (20) of Chapter III, we use (21), which differs from it by the quantity

$$21''.49+V_2,$$

which is the number of Hansen's Table XLI.

The system of longitudes thus corrected will be designated by the symbol N_1, and the amount of the correction by the symbol ΔH. The numerical expressions for ΔH in its two forms are:

1. Applicable to the mean longitude of Hansen's tables unchanged:

$$\Delta H=-1''.14-29''.17\,T-3''.76\,T^2-V_2-15''.5\cos A,$$

where

$$V_2=21''.47\sin(8\,V-13\,E+274°\,14')$$

2. To be used when we omit Hansen's Table XLI:

$$\Delta' H=\Delta H+21''.49+V_2,$$

$$=20''.35-29''.17\,T-3''.76\,T^2-15''.5\cos A.$$

We then have

$$N_1=H+\Delta H.$$

The system N_1 is that of the ephemeris in the Nautical Almanac and American Ephemeris since 1883.0, except the Nautical Almanac longitude, which is still H.

3. It will be seen that N_1 makes no change in or addition to Hansen's terms of short or mean period. Both H and N_1 therefore require a large number of theoretical corrections. These are discussed in Chapter III, and their sum will be designated by the symbol ΔN. The ephemeris thus corrected is the provisional one of the present work and will be designated as N_2. Thus we have

$$N_2=N_1+\Delta N=H+\Delta H+\Delta N.$$

4. In N_1 and N_2 is included the empirical term of long period $-15''.5\cos A$. N_1 and N_2 also require two minute corrections of long period, which have been omitted because one was not fully ascertained and the other is too small to affect our present conclusions.

Our first step in the present discussion must be to compare the observations with the results of pure gravitational theory. But in the latter theory we may leave the secular acceleration as an arbitrary quantity because, owing to the unknown tidal retardation, its theoretical value must require some modification.

In this pure theory we shall leave the mean longitude, mean motion, and secular acceleration of N_1 and N_2 unchanged. The reductions of the provisional theory to pure theory will then be the following:

(A), the subduction of the empirical term $-15''.5\cos A$, which is found in the table on page 30.

(B), the application of the small omitted term of long period, of which the argument is $8V-13E$, and therefore the same as that of Hansen's omitted empirical term. The adopted value is that which I have derived in my recent work, Action of the Planets on the Moon, and is practically identical with that derived by Brown and by Radau.

(C), the correction of Hansen's Venus term of long period,

$$15''.34\sin(18\,V-16\,E-g+30°.2),$$

which is so near the truth that it has been retained unchanged in the provisional ephemeris. But

it now seems desirable to introduce any correction which it may require. The values recently computed are the following:

Newcomb (1)[a]	$\delta\lambda = 14''.75 \sin (A + 30^\circ.5)$
Newcomb (2)[b]	$\delta\lambda = 14''.77 \sin (A + 29^\circ.9)$
Brown[c]	$\delta\lambda = 14''.49 \sin (A + 29^\circ.0)$
Radau[d]	$\delta\lambda = 14''.42 \sin (A + 30^\circ.0)$
Brown	$\delta\lambda = 14''.27 \sin (A + 29^\circ.0)$

Until more light can be thrown upon the unexplained fluctuations of long period in the observed longitude of the moon, the differences between these five values are of no practical importance. The following remarks upon the possible doubts that may attach to each may, however, be worthy of consideration:

The first value, which was computed about 1874, but not published until twenty years later, is uncertain in one of the combinations which enter into it, as is explained in the work itself. The coefficient derived may well be too large by an unimportant fraction of a second.

The second value was the first one in which the effect of the second order arising from the mutual perturbations of the Earth and Venus is included. In fact, the determination of this effect was the principal purpose of the computation. The development of the planetary terms was made by what is commonly called mechanical quadrature, but the division of the circle was not carried sufficiently far. The uncertainty thus arising is estimated by the author at about $0''.3$. The values of Brown and Radau are computed by developing in powers of the eccentricities and inclinations. Brown's last value includes all second-order terms. Before completing the study I adopted the expression

$$\varDelta\lambda = 14.''55 \sin (A + 29^\circ.2).$$

This is a weighted mean of the second and third values preceding, when weight 4 is assigned to the third.

I have little doubt that it is too large unless the mass of Venus should be found to require a positive correction. But, whatever the difference may be, it is entirely unimportant for our present purpose. This gives for the correction of Hansen's value adopted in N_2 the expression:

$$\varDelta\lambda = -0''.56 \sin A - 0''.62 \cos A = 0''.83 \sin (A + 228^\circ).$$

(D), we have finally the correction $\varDelta\lambda = -0''.0067 T^3$ already derived, necessary only in the ancient observations.

Brown has also found a term with a coefficient of more than half a second having a period of 1,800 years. The consideration of this term under present circumstances is quite unnecessary.

The sum of these four corrections to reduce N_2 to gravitational theory I shall call $\varDelta Th$. Its numerical expression is:

$$\varDelta Th = 15''.5 \cos A + 0''.83 \sin (A + 228^\circ) + 0''.25 \sin B - 0''.0067 T^3,$$

where

$$A = 18\,V - 16\,E - g = 183^\circ.9 + 131^\circ.92\ T,$$
$$B = 8\,V - 13\,E + 225^\circ = 87^\circ + 150^\circ\ T.$$

[a] Astronomical Papers of the American Ephemeris, Vol. V, Pt. III, p. 286. The coefficient is here corrected for the mass of Venus and for the indirect action.

[b] Action of the Planets on the Moon: Publications of the Carnegie Institution No. 72, June, 1907, p. 140.

[c] Monthly Notices, R. A. S.: LXVIII, January, p. 156.

[d] Annales de l'Observatoire de Paris, Memoires, Tome XXI, p. B 113.

The ephemeris of mean longitudes for pure theory is:

$$Th = N_2 + \varDelta Th = H + \varDelta H + \varDelta N + \varDelta Th.$$

The values of $\varDelta$Th for the modern period are formed in the table below as follows:

Column (1) gives the value of 15″.5 cos A.
Column (2) gives the value of 0″.83 sin (A+228°).
Column (3) gives the value of 0″.25 sin B.

The sum of the three is the reduction from N_2 to pure theory.

Year.	(1)	(2)	(3)	⊿Th	Year.	(1)	(2)	(3)	⊿Th
	″	″	″	″		″	″	″	″
1620	+ 9.20	+0.09	+0.01	+ 9.30	1770	−12.59	+0.18	+0.17	−12.24
1630	+11.81	−0.11	−0.05	+11.65	1780	−14.32	+0.36	+0.21	−13.75
1640	+13.79	−0.30	−0.11	+13.38	1790	−15.29	+0.52	+0.24	−14.53
1650	+15.04	−0.46	−0.17	+14.41	1800	−15.46	+0.65	+0.25	−14.56
1660	+15.50	−0.61	−0.21	+14.68	1810	−14.82	+0.75	+0.24	−13.83
1670	+15.14	−0.72	−0.24	+14.18	1820	−13.39	+0.81	+0.22	−12.36
1680	+13.98	−0.80	−0.25	+12.93	1830	−11.26	+0.83	+0.19	−10.24
1690	+12.08	−0.83	−0.24	+11.01	1840	− 8.53	+0.80	+0.14	− 7.59
1700	+ 9.54	−0.82	−0.22	+ 8.50	1850	− 5.35	+0.73	+0.08	− 4.54
1710	+ 6.51	−0.76	−0.19	+ 5.56	1860	− 1.89	+0.63	+0.01	− 1.25
1720	+ 3.13	−0.67	−0.14	+ 2.32	1870	+ 1.67	+0.49	−0.05	+ 2.11
1730	− 0.41	−0.54	−0.08	− 1.03	1880	+ 5.14	+0.32	−0.11	+ 5.35
1740	− 3.94	−0.38	−0.01	− 4.33	1890	+ 8.34	+0.14	−0.17	+ 8.31
1750	− 7.26	−0.21	+0.05	− 7.42	1900	+11.10	−0.05	−0.21	+10.84
1760	−10.17	−0.01	+0.11	−10.07	1910	+13.28	−0.24	−0.24	+12.80

Chapter X.

DISCUSSION OF THE MOON'S MEAN MOTION IN LONGITUDE.

49. From the preceding reductions and corrections and from the material found in the Researches of 1878 it is now proposed to discuss the moon's mean motion in longitude from all observations, ancient and modern, and to determine the fluctuations in mean longitude which can not be explained by theory. The material on which this discussion is based is the following:

(*A*) The ancient eclipses of the moon used by Ptolemy in his Almagest to determine the elements of the moon's motion.

(*B*) The Arabian observations of eclipses collected by Ibn Junis.

(*C*) Occultations of stars between 1621 and 1750, including occultations and eclipses observed by Bullialdus, Gassendus, and Hevelius between 1620 and 1690, as discussed in the Researches of 1878.

(*D*) Modern occultations from 1750 to 1908, the results of which have already been tabulated.

Were there no unaccounted-for fluctuations in the mean longitude, all the corrections to that element could be represented in the form $a+bt+ct^2$. But this is found not to be the case, and the fluctuations of $\Delta\lambda$ require a special treatment of the equations.

Although the observations of importance before 1750 are published and discussed in the Researches of 1878, where they are compared with the longitudes of Hansen's tables, it seems desirable, in view of the importance of the subject, to revise the discussion on all points where additional light has been thrown by recent researches or by mature consideration.

The rediscussion of the first two of the preceding periods has been carried through quite independently in a very valuable paper by Mr. Nevill,[a] in which these observations are discussed with great thoroughness. Mr. Nevill's work was, in fact, unnoticed by me at the time of making the present rediscussion. But it will be of great interest to compare his results with those independently reached by myself, and this I have done in part.

The deviation of the revised results from the earlier ones is so small that no extended presentation of the revision seems necessary. The main points are the following:

The first eclipse of the series, -720, March 19, is quite discordant, as was pointed out by Mr. Nevill shortly after my paper was published. The statement as quoted by Ptolemy is that "the eclipse began when one hour had quite far passed after the rising" (of the moon). Ptolemy has assumed an hour and a half as the interval but it seemed to me more likely to be earlier than this. But on submitting the question of the admissible range of interpretation to Professor Carroll, of the George Washington University, the possible range of time seemed so wide that Ptolemy's estimate was accepted.

In the earlier work a somewhat problematic correction of the times was applied on account of the interval between the beginning of an eclipse and the time when it first became visible. But I have been led to drop this correction, because the darkness of the moon might be seen before the actual entrance of the limb into the shadow. In fact, a comparison of the results would lead to the conclusion that the beginning was recorded even earlier than the actual phase of totality.

Period A.—The system on which the author proceeded in his former discussion of these eclipses was to reach a conclusion as to the reliability and probable error of each phase described

[a] Monthly Notices, R. A. S., Vol. LXVII, p. 2; 1906–7.

by Ptolemy without respect to discordances between observation and theory. Assuming only normal sources of error this proceeding is logically the best. It avoids the objectionable process of rejecting or retaining observations of equal value, according as they do or do not coincide with the results of other observations. At the same time it must be admitted that abnormalities are possible which would require an observation to be rejected.

The most troublesome eclipse to deal with is the first quoted by Ptolemy, of which the year is −720. The time of beginning is discordant from the others by more than half an hour. In the discussion of the subject, which appeared shortly after the publication of the work, Mr. Nevill shows the discordance between the first four Babylonian eclipses and all the others in a strong light and reaches the conclusion that this group should have been thrown out entirely.

The writer does not conceive that the discordance is such that this proceeding would be justifiable. The furthest he has thought it admissible to go in the direction suggested by Nevill is to adopt Ptolemy's conclusion as to time of beginning of the first eclipse, making it one hour thirty minutes after moonrise, instead of one hour twenty-two minutes, which was first done. The results are as follows: First is shown the corrections to tabular times given by the observations and the respective weights in the old work; then the results which are now adopted in preference. The second eclipse of the group was in the early discussion rejected entirely owing to the uncertainty of the time, which was stated as the middle of the night. It is now retained with a small weight. Another change which we have made in the present discussion is to omit a somewhat conjectural correction to the times of beginning and ending on the ground that the eclipse would not be seen as beginning until some minutes after the moon had impinged upon the shadow of the earth. On further consideration it appears to me that as the darkening of the moon's limb would be very perceptible, even before the moment of entering into the shadow, and as we may presume the eclipses were expected, the more probable supposition now seems to be that the first contact with the actual shadow was observed. This course is greatly strengthened by the fact that a comparison between the recorded times of beginning and ending of the two eclipses, both phases of which are observed, show a longer duration of the total phase than that taken by the moon in passing through the shadow itself.

The whole series of Ptolemaic eclipses may be divided into four groups and the mean taken. The following is a comparison of the work of 1878 with the revised work of 1908. Δt is the correction to the tabular time as computed from Hansen's tables:

Date.	T.	Δt (1878).	Δt (1908).	Δt (Nevill).
	c	m	m	m
−720, Mar. 19	−25.2	+ 8; wt. 3	+18; wt. 2	+23; wt. 2
−719, Mar. 18	−25.2	+63; wt. 0	+63; wt. 0.5	+63; wt. 0.5
−719, Sept. 1	−25.2	+43; wt. 1	+43; wt. 1	+43; wt. 2
−620, Apr. 21	−24.2	+44; wt. 2	+44; wt. 2	+44; wt. 3

Thus modified, the mean correction to the tabular time given by the group is $+36^m$, and to the Hansenian mean longitude of the moon $-18'$. The mean of Nevill's results is 39^m and $-19'$.

I have also subjected the results from the other eclipses to some slight revision, making the mean results for groups and the corrections to the adopted theory as follows:

Epoch.	T.	Obs.—H.	Nev.	Th—H.	Obs.—Th.
	c	′	′	′	′ ′
−684	−24.8	−18.0	−19	−25.0	+7.0±4
−381	−21.8	−26.5	−26	−18.0	−8.5±3
−189	−19.9	−18.5	−17	−14.2	−4.3±4
+134	−16.7	−15.0	−15	− 8.8	−6.2±3

In the preceding I have taken no account of Hansen's erroneous Venus term, but have in what follows.

Period B.—In the former work the Arabian observations were worked up so carefully that I do not deem it necessary to revise the results. The means and their reduction to theory are the following:

Epoch.	T.	Obs. – H.	Th – H.	Obs. – Th.
	c	′	′	′ ′
850	–9.5	–3.8	–1.2	–2.6±2.4
927	–8.7	–1.6	–0.1	–1.5±1.7
986	–8.1	–4.5	–0.1	–4.4±1.3

Nevill has revised these eclipses, making a few changes and additions based on a study of the Arabian originals. The use of his work would add to the weight of the results without, I think, materially changing the general mean.

Periods C and D.—The observations of the years 1620–1670 are fully worked up in Researches of 1878, pages 205–230, and the results collected in pages 231–248. Including both eclipses and occultations I have formed the following mean corrections to the moon's longitude from the observations of Bullialdus, Gassendus, and Hevelius, from the separate results of the Researches of 1878. The column Th—H contains the sum of the reductions in the table on page 30 and $\varDelta$ Th in the preceding section.

Year.	Obs. – H.	Th – H.	Obs. – Th.
	″	″	″ ″
1621	+78	+54	+24±14
1635	+54	+57	– 3± 7
1639	+27	+56	–29± 5
1645	+44	+56	–12± 6
1653	+34	+55	–21± 8
1662	+36	+52	–16± 4

For the years 1672–1908 I have adopted mean results from the smoothed-off means of §46. In forming these corrections for the purpose in question, their fluctuations are seen to be such that it is quite useless to aim at definitive values of the corrections. Approximate preliminary values are as good as the best until something is learned of the law or cause of the fluctuations.

50. ***Observed mean corrections to the purely theoretical longitude of the moon through the period of 2,592 years, from –684 to 1908, with their probable errors:***

Year.	$\varDelta\lambda$	p. e.	Year.	$\varDelta\lambda$	p. e.
	″	″		″	″
– 684	+420	240	1737	+ 2.8	1
– 381	–510	180	1747	+ 6.0	1
– 189	–258	240	1757	+ 8.3	1
+ 134	–372	180	1780	+13.9	1
850	–156	144	1795	+13.3	1
927	– 90	102	1806	+12.4	1
986	–264	78	1820	+11.5	1
1621	+ 24	14	1830	+ 8.3	1
1635	– 3	7	1840	+ 7.6	1
1639	– 29	5	1850	+ 6.3	1
1645	– 12	6	1860	+ 6.2	1
1653	– 21	6	1870	– 0.3	1
1662	– 16	4	1880	– 4.1	1
1681	– 14	1	1890	– 8.5	1
1710	– 5.2	1	1900	– 7.6	1
1727	– 0.1	1	1908	– 6.3	1

51. *Preliminary solution of the equations of condition for the moon's mean motion.*—If the moon's mean motion could be represented by gravitational theory, its derivation from the preceding corrections given by observation would be extremely simple. It would require only the solution by least squares of equations of condition involving three unknown quantities, the mean longitude at any selected epoch, the mean motion at that epoch, and the secular acceleration. But, as I have already remarked, and as is evident from the run of the corrections, there are fluctuations in the motion which make it impossible to derive any definite result without taking them into account. The difficulty of the problem is increased by the fact that we can make no plausible assumption as to the permanent form of these fluctuations. So long as they might be supposed to arise from defects in the computations of gravitational theory we might plausibly suppose them to arise from actual periodic terms which had eluded our scrutiny. But to-day it seems almost as certain as any proposition in mathematical science can be that there are no known masses of matter, the gravitational action of which could produce the observed effects. Working quite independently of each other, I feel that Brown and I have examined every possible term and made such estimation of its limiting possible magnitude as to ensure the correctness of our conclusions. Brown has gone yet further by finding the limiting value of any possible omitted term to be insensible. In the Researches of 1878 I brought out the curious result that the great fluctuation could be represented by a very small change in the argument and coefficient of the Hansenian Venus term; in fact, that little more was necessary than to change the algebraic sign of the constant term in the argument. I did not notice at the time that the angle to be changed could be practically identified with the longitude of the node of Venus, in which no change is of course possible. The singular coincidence must therefore be regarded as accidental, in view of the fact already cited that several fundamentally different ways lead to the same result.

A similar remark applies to the term of nearly the same long period arising from the argument 13 E−8 V, which gives rise to an important term in the mutual action of the Earth and Venus. It seems to be fully proven that there can be no corresponding term in the motion of the moon except the unimportant one first computed by Delaunay.

Additional weight is given to our negative conclusion by the fact that although the great fluctuation may be represented by a term of about 270 years, even the introduction of this term fails to completely represent the observations. There are still fluctuations outstanding which it is impossible to reconcile with gravitational theory, and, in fact, which do not admit of representation by a trigonometric series without introducing a number of terms, each purely empirical, and which we can have no reason for believing to be expressions of the actual law, if law there be.

One conclusion from these facts is that there is no value which we can assign to the moon's undisturbed mean motion as definitive. Representing the mean longitude in the form

$$\lambda = a + bt + st^2 + F,$$

where F represents the sum of all the fluctuations, we have no assurance that any empirical formula we may construct for F will not in the future be found to require a correction of the same form as the sum of the three terms of λ above given. The coefficients of this correction will then have to be subtracted from the corresponding values of a, b, and s, so as to insure the best general representation of the observed facts. Thus, no such values can be definitive until we succeed in establishing the form of F in its completeness.

Another proceeding may also be adopted. Since we know nothing of the actual law of F, it may be claimed that we should make no hypothesis as to that law, but determine a, b, and s so as to make F as small as possible in a general way.

We shall solve the equations by both these methods, beginning with that first named. But it must be remarked that, even in this solution, we have to adopt the principle of the second method,

except as to the great fluctuation of long period. The amplitude of this fluctuation, in fact, represents the largest part of the value of F, but by no means all of it.

What we have first to do is, therefore, to represent the excess of the observed over the theoretical mean longitude in the form

$$x + yT + zT^2 + c \sin (A + Bt),$$

where c, A and B are to be determined so as best to represent the observations.

To effect the solution we express the fluctuation in the form

$$c \sin (A + Bt) = u \sin Bt + v \cos Bt,$$

where

$$u = c \cos A,$$
$$v = c \sin A.$$

Since the unknown quantity B does not enter in a linear form, our easiest course is to find by trial what value of this quantity will lead to the best solution. I have actually assumed the following four values of B:

$$B = 1^\circ.2;\ 1^\circ.3;\ 1^\circ.4;\ 1^\circ.5.$$

In forming the equations the question of the weights to be assigned would be a difficult one were it possible to derive determinate values of them. But, from the nature of the case, this is not possible. The outstanding residuals are not in the nature of independent deviations, but are markedly systematic. From the commencement of fairly precise observations in 1672 until the present time the purely accidental errors of observation are markedly less than the outstanding fluctuations, which are systematic in their character. What I have done is to assume each decennial mean result during the period since 1680 to be affected by a probable error $\pm 1''$. This is doubtless smaller than the probable value of the outstanding residual; but its acceptance may be justified by the fact that the end at which we are practically aiming is that of predicting the moon's motion during the next 25 years, and that we can probably best do this by making our empirical theory fit as well as may be into modern observations.

Where the probable errors and the coefficients of the equation are both so large as in the case of the ancient observations the most convenient method of reducing the conditional equations is to divide each by its probable error, so that the weight shall be the same throughout.

From the uncertain character of the fluctuating term neither the ancient nor the mediæval observations can be of use in its determination. It is therefore only necessary to introduce the coefficients of the fluctuation into the modern observations.

Equations of Condition of Equal Weight for the Assumed Values of B.

				B=1°.20		B=1°.30		B=1°.40		B=1°.50		″	p. e.
−681	0.00x	−0.10y	+2.58z									=+ 1.8	240
−381	0.00	−0.12	+2.64									=− 2.8	180
−189	0.00	−0.08	+1.65									=− 1.1	240
+131	+0.01	−0.09	+1.54									=− 2.1	180
850	+0.01	−0.07	+0.63									=− 1.1	144
927	+0.01	−0.09	+0.76									=− 0.9	102
986	0.00	−0.10	+0.85									=− 3.4	78
1621	+0.07	−0.13	+0.23	+0.04u	−0.06v	+0.06u	−0.04v	+0.07u	−0.02v	+0.07u	+0.00v	=+ 1.7	14
1635	+0.14	−0.26	+0.39	+0.04	−0.14	+0.08	−0.12	+0.11	−0.09	+0.13	−0.05	=− 0.4	7
1639	+0.20	−0.32	+0.52	+0.05	−0.19	+0.10	−0.17	+0.14	−0.14	+0.18	−0.10	=− 5.8	5
1645	+0.17	−0.26	+0.40	+0.02	−0.16	+0.06	−0.15	+0.10	−0.13	+0.13	−0.10	=− 2.0	6
1653	+0.17	−0.25	+0.36	−0.01	−0.17	+0.04	−0.16	+0.07	−0.15	+0.11	−0.13	=− 3.5	6
1662	+0.25	−0.35	+0.48	−0.06	−0.24	0.00	−0.25	+0.06	−0.24	+0.11	−0.22	=− 4.0	4
1681	+1.00	−1.19	+1.42	−0.61	−0.80	−0.43	−0.90	−0.23	−0.97	−0.03	−1.00	=−14.0	1
1710	+1.00	−0.90	+0.81	−0.95	−0.31	−0.89	−0.45	−0.81	−0.59	−0.71	−0.71	=− 5.2	1

Equations of Condition of Equal Weight for the Assumed Values of B—Continued.

				B=1°.20		B=1°.30		B=1°.40		B=1°.50		"	p. e.
1727	+1.00x	−0.73y	+0.53z	−1.00u	+0.04v	−1.00u	−0.09v	−0.98u	−0.21v	−0.94u	−0.33v	=− 0.1	1
1737	+1.00	−0.63	+0.40	−0.97	+0.25	−0.99	+0.14	−1.00	+0.03	−1.00	−0.08	=+ 2.8	1
1747	+1.00	−0.53	+0.28	−0.89	+0.44	−0.93	+0.36	−0.96	+0.27	−0.98	+0.18	=+ 6.0	1
1757	+1.00	−0.43	+0.18	−0.78	+0.62	−0.83	+0.56	−0.87	+0.50	−0.90	+0.43	=+ 8.3	1
1780	+1.00	−0.20	+0.04	−0.41	+0.91	−0.44	+0.90	−0.47	+0.88	−0.50	+0.87	=+13.9	1
1795	+1.00	−0.05	0.00	−0.10	+1.00	−0.11	+0.99	−0.12	+0.99	−0.13	+0.99	=+13.3	1
1806	+1.00	+0.06	0.00	+0.13	+0.99	+0.14	+0.99	+0.15	+0.99	+0.16	+0.99	=+12.4	1
1820	+1.00	+0.20	+0.04	+0.41	+0.91	+0.44	+0.90	+0.47	+0.88	+0.50	+0.87	=+11.5	1
1830	+1.00	+0.30	+0.09	+0.59	+0.81	+0.63	+0.78	+0.67	+0.74	+0.71	+0.71	=+ 8.3	1
1840	+1.00	+0.40	+0.16	+0.74	+0.67	+0.79	+0.62	+0.83	+0.56	+0.87	+0.50	=+ 7.6	1
1850	+1.00	+0.50	+0.25	+0.87	+0.50	+0.91	+0.42	+0.94	+0.34	+0.97	+0.26	=+ 6.3	1
1860	+1.00	+0.60	+0.36	+0.95	+0.31	+0.98	+0.21	+1.00	+0.10	+1.00	0.00	=+ 6.2	1
1870	+1.00	+0.70	+0.49	+1.00	+0.10	+1.00	−0.02	+0.99	−0.14	+1.00	−0.26	=− 0.3	1
1880	+1.00	+0.80	+0.64	+1.00	−0.10	+0.97	−0.24	+0.93	−0.38	+0.87	−0.50	=− 4.1	1
1890	+1.00	+0.90	+0.81	+0.95	+0.31	+0.89	−0.45	+0.81	−0.59	+0.71	−0.71	=− 8.5	1
1900	+1.00	+1.00	+1.00	+0.87	+0.50	+0.77	−0.64	+0.64	−0.77	+0.50	−0.87	=− 7.6	1
1908	+1.00	+1.08	+1.17	+0.77	+0.64	+0.64	−0.77	+0.48	−0.88	+0.31	−0.95	=− 6.3	1

The following normal equations, corresponding to the assumed values of B, were then formed:

B=1°.20

					"
+19.19 x	+1.60 y	+ 9.13 z	+ 2.57 u	+4.71 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 9.47	+0.28	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.50	−2.46	=− 56.6
+ 2.57	+9.47	+ 1.50	+11.79	+0.14	=− 3.7
+ 4.71	+0.28	− 2.46	+ 0.14	+7.43	=+100.7

B=1°.30

					"
+19.19 x	+1.60 y	+ 9.13 z	+ 2.59 u	+3.14 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 8.91	+0.05	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.58	−3.44	=− 56.6
+ 2.59	+8.91	+ 1.58	+11.47	−0.13	=− 4.7
+ 3.14	+0.05	− 3.44	− 0.13	+7.68	=+102.6

B=1°.40

					"
+19.19 x	+1.60 y	+ 9.13 z	+ 2.57 u	+1.60 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 8.20	−0.31	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.63	−4.35	=− 56.6
+ 2.57	+8.20	+ 1.63	+11.02	−0.35	=− 5.5
+ 1.60	−0.31	− 4.35	− 0.35	+8.14	=+104.0

B=1°.50

					"
+19.19 x	+1.60 y	+ 9.13 z	+ 2.51 u	+0.26 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 7.42	−0.55	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.63	−5.09	=− 56.6
+ 2.51	+7.42	+ 1.63	+10.54	−0.41	=− 5.9
+ 0.26	−0.55	− 5.09	− 0.41	+8.71	=+104.2

The results obtained from a solution of these normal equations are exhibited in the following table:

Assumed Annual Motion of Argument.	1°.20	1°.30	1°.40	1°.50
Length of period in years	300	277	257	240
$x=$	$-\ 0''.59$	$+\ 0''.71$	$+\ 1''.77$	$+\ 2''.67$
$y=$	$+\ 2''.81$	$+\ 2''.59$	$+\ 2''.97$	$+\ 2''.89$
$z=$	$-\ 0''.40$	$-\ 0''.47$	$-\ 0''.46$	$-\ 0''.53$
$u=$	$-\ 2''.55$	$-\ 2''.36$	$-\ 2''.66$	$-\ 2''.70$
$v=$	$+13''.70$	$+12''.80$	$+12''.20$	$+11''.63$
$c=$	$13''.94$	$13''.01$	$12''.49$	$11''.94$
A=	100°.6	100°.5	102°.3	103°.1
Sum of squares of residuals	82".6	77".0	81".2	91".6

We deduce from the above table Σpvv a minimum for B= 1°.31. The values of the elements corresponding are

x=Correction of λ for 1800	$+\ 0''.83$
y=Correction of centennial motion	$+\ 2''.60$
z=Correction of secular acceleration	$-\ 0''.47$
$u=c\cos A$	$-\ 2''.37$
$v=c\sin A$	$+12''.73$
$c=$	$12''.95$
A=	100°.6

The great fluctuation is therefore

$$\delta v = 12''.95 \sin \left\{ 1^\circ.31\ (t-1800.0) + 100^\circ.6 \right\}.$$

Period=275 years.

The definitive results for the moon's mean longitude may now be summed up as follows:

Fundamental Epoch, 1800, Jan. 0, G. M. N.
T, time from this epoch in Julian Centuries.

The expression for Hansen's mean longitude, measured from the moving mean equinox is

$$\lambda = 335^\circ\ 43'\ 26''.70 + (1336^{\text{rev.}} + 1108419''.61)T + 13''.301T^2 + 0''.01347T^3.$$

The reduction of this to the provisional systems N_1 and N_2 is

$$\varDelta H = -1''.14 - 29''.17T - 3''.76T^2 - 0''.0067T^3.$$

We have just formed the further correction

$$\varDelta N_2 = +0''.83 + 2''.60T - 0''.47T^2,$$

making the entire correction to Hansen

$$\varDelta\lambda H = -0''.31 - 26''.57T - 4''.23T^2 - 0''.0067T^3,$$

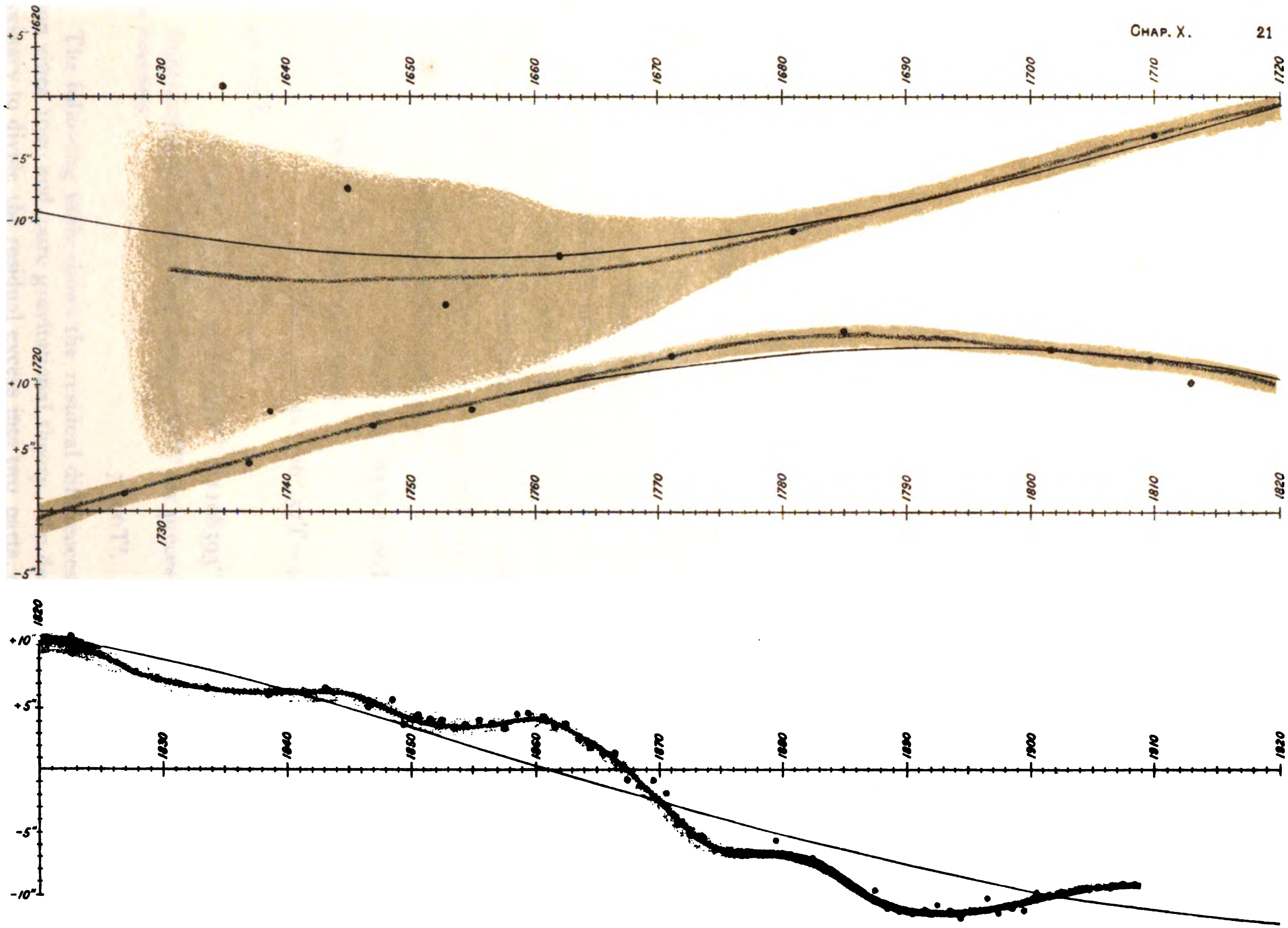
and giving for the undisturbed value

$$\lambda = 335^\circ\ 43'\ 26''.39 + (1336^{\text{rev.}} + 1108393''.04)T + 9''.071T^2 + 0''.0068T^3.$$

Subtracting from the third term $1''.11T^2$ for precession, the observed sidereal secular acceleration becomes

$$7''.96T^2.$$

The following table shows the residual differences between the result of observations of the moon since 1620 and pure gravitational theory. In deriving the elements of mean motion it was necessary to divide the residual excess into two parts, one the great fluctuation just described, the other the smaller fluctuations which were superimposed upon it. In the table, the second column gives the minor fluctuations, which are in fact the residuals of the conditional equations. The



UNEXPLAINED FLUCTUATIONS IN THE MOON'S MEAN LONGITUDE: 1630–1908.

third column shows the main fluctuation as computed from the expression given above. The sum of the two found in the fourth column is the total excess of the moon's observed longitude over the result of gravitational theory. It is, however, to be remarked that in this theory is included the excess of the observed over the theoretical secular acceleration.

The unit of weight, as the latter is given in the last column, corresponds to a probable error of about $\pm 0''.9$, and a mean error of about $\pm 1''.3$. Being in many cases partly a matter of judgment, round numbers are preferred where it is doubtful. The limiting value assigned is 60, it being judged that the actual probable error can never be below $\pm 0''.12$.

Mean date.	Minor res.	Great fluctuation.	Total fluctuation.	Wt.	Mean date.	Minor res.	Great fluctuation.	Total fluctuation.	Wt.
	"	"	"			"	"	"	
1621.0	+39.0	− 9.6	+29.0	0.005	1866.5	+2.8	− 1.6	+ 1.2	6.0
1635.0	+13.0	−11.7	+ 1.0	0.02	1867.5	+1.1	− 1.9	− 0.8	5.0
1639.0	−13.0	−12.1	−25.0	0.04	1868.5	+1.0	− 2.2	− 1.2	10.0
1645.0	+ 5.0	−12.6	− 8.0	0.03	1869.5	+1.6	− 2.5	− 0.9	9.0
1653.0	− 4.0	−12.9	−17.0	0.03	1870.5	+0.7	− 2.8	− 2.1	6.0
1662.0	0.0	−12.7	−13.0	1.06	1871.5	−1.3	− 3.1	− 4.4	10.0
1681.0	− 0.4	−10.5	−10.9	2.0	1872.5	−1.8	− 3.3	− 5.1	16.0
1710.0	+ 0.5	− 3.7	− 3.2	6.0	1873.5	−1.8	− 3.6	− 5.4	12.0
1727.0	+ 0.1	+ 1.2	+ 1.3	3.0	1874.5	−2.2	− 3.9	− 6.1	8.0
1737.0	− 0.2	+ 4.1	+ 3.9	6.0	1875.5	−2.3	− 4.2	− 6.5	8.0
1747.0	0.0	+ 6.8	+ 6.8	5.0	1876.5	−2.1	− 4.4	− 6.5	30.0
1755.0	− 0.3	+ 8.7	+ 8.4	2.0	1878.0	−1.8	− 4.8	− 6.6	18.0
1771.0	+ 1.4	+11.2	+12.6	9.0	1879.5	−0.5	− 5.2	− 5.7	14.0
1784.7	+ 1.6	+12.7	+14.3	5.0	1880.5	−1.4	− 5.5	− 6.9	20.0
1792.0	+ 0.3	+12.9	+13.2	10.0	1881.5	−1.6	− 5.7	− 7.3	12.0
1801.5	− 0.6	+12.7	+12.1	12.0	1882.5	−1.4	− 6.0	− 7.4	8.0
1809.5	− 0.1	+11.9	+11.8	16.0	1883.5	−2.2	− 6.2	− 8.4	7.0
1813.0	− 1.2	+11.5	+10.3	16.0	1884.5	−2.1	− 6.5	− 8.6	30.0
1821.0	+ 0.1	+10.3	+10.4	14.0	1885.5	−2.5	− 6.7	− 9.2	50.0
1822.5	+ 0.6	+10.0	+10.6	10.0	1886.5	−2.8	− 7.0	− 9.8	18.0
1829.5	− 1.6	+ 8.6	+ 7.0	20.0	1887.5	−2.6	− 7.2	− 9.8	20.0
1833.5	− 1.6	+ 7.7	+ 6.1	10.0	1888.5	−3.5	− 7.5	−11.0	8.0
1838.5	− 0.6	+ 6.4	+ 5.8	30.0	1889.5	−3.5	− 7.7	−11.2	7.0
1843.0	+ 1.1	+ 5.2	+ 6.3	20.0	1890.5	−3.4	− 8.0	−11.4	10.0
1846.5	+ 1.1	+ 4.2	+ 5.3	10.0	1891.5	−3.1	− 8.2	−11.3	16.0
1848.5	+ 1.9	+ 3.7	+ 5.6	8.0	1892.5	−2.6	− 8.4	−11.0	17.0
1849.5	+ 0.1	+ 3.4	+ 3.5	15.0	1893.5	−2.7	− 8.6	−11.3	15.0
1850.5	+ 1.0	+ 3.2	+ 4.2	18.0	1894.5	−3.0	− 8.8	−11.8	30.0
1851.5	+ 0.8	+ 2.9	+ 3.7	12.0	1895.5	−2.2	− 9.0	−11.2	60.0
1852.5	+ 0.9	+ 2.6	+ 3.5	8.0	1896.5	−1.2	− 9.2	−10.4	60.0
1853.5	+ 0.7	+ 2.3	+ 3.0	7.0	1897.5	−2.0	− 9.5	−11.5	20.0
1854.5	+ 1.4	+ 2.0	+ 3.4	14.0	1898.5	−1.5	− 9.7	−11.2	28.0
1855.5	+ 2.1	+ 1.7	+ 3.8	6.0	1899.5	−1.4	− 9.9	−11.3	12.0
1856.5	+ 1.9	+ 1.4	+ 3.3	6.0	1900.5	0.0	−10.1	−10.1	15.0
1857.5	+ 2.1	+ 1.1	+ 3.2	9.0	1901.5	−0.1	−10.3	−10.4	16.0
1858.5	+ 3.5	+ 0.8	+ 4.3	8.0	1902.5	+0.3	−10.5	−10.2	18.0
1859.5	+ 3.9	+ 0.5	+ 4.4	6.0	1903.5	+0.6	−10.6	−10.0	12.0
1860.5	+ 3.9	+ 0.2	+ 4.1	12.0	1904.5	+1.1	−10.8	− 9.7	20.0
1861.5	+ 3.3	− 0.1	+ 3.2	5.0	1905.5	+1.5	−11.0	− 9.5	20.0
1862.5	+ 3.9	− 0.4	+ 3.5	7.0	1906.5	+1.3	−11.1	− 9.8	16.0
1863.5	+ 3.0	− 0.7	+ 2.3	6.0	1907.5	+2.0	−11.3	− 9.3	15.0
1864.5	+ 2.9	− 1.0	+ 1.9	10.0	1908.3	+2.1	−11.4	− 9.3	9.0
1865.5	+ 2.6	− 1.3	+ 1.3	5.0					

The accompanying plate gives a graphical representation in three sections of the residual deviations from pure theory, the motion derived from gravitational theory being represented by the straight medial lines. In order to show clearly the two parts into which the total fluctuation is divided, the term of great fluctuation is represented by a fine, sharp curve. The curve of actual longitude is bounded on each side by a shaded area showing the mean error at each point, which is nearly $^3/_2$ of the probable error. In this way not only the fluctuations as shown by observation are exhibited, but also the error to which the curve may be subject, the probability being $2/3$ that at any point the true curve lies inside the shaded area, and $1/3$ that it lies without it.

Chapter XI.

DISCUSSION OF THE REMAINING ELEMENTS WHICH CAN BE DETERMINED FROM THE OCCULTATIONS.

Section I.—Preliminary Solution.

52. As I have already several times remarked, observations of occultations are of special value in determining other astronomical elements than the moon's mean longitude, partly because of the early period when fairly good observations were begun and partly because of their comparative freedom from the systematic errors which affect meridian observations of the moon. It is now proposed to do for the equations of the period 1753–1908 what I have already done for the earlier occultations—solve the equations for the remaining unknown quantities.

The method which I shall adopt is, as for the older occultations, to regard the moon's mean longitude known with all the necessary precision from the preceding discussion so that it becomes a known quantity and then to substitute this in the first member of the equations and transpose the resulting term to the second term of the equation. The equations will then be solved for the remaining unknown quantities.

I do not disguise the fact that some question may be raised as to the rigor of this mode of proceeding, especially in the case of those unknown quantities which are correlated with the mean longitude. But I, notwithstanding, think that the results will be of interest and will probably be more accurate than those obtainable in any other way.

53. *Weights of the equations.*—In solving for the mean longitude we have made little distinction of weights except to reject abnormally discordant observations. But, in the present solution, it seems advisable to adopt a logically more rigorous method of procedure owing to the abnormal and systematic character of the statistical distribution of the residuals.

If this distribution followed the normal law the derivation of the results by the method of least squares would require only numerical computations by well-known methods, in which the judgment would be allowed no play. There would then be no room either for difference of opinion as to the treatment or for the exercise of judgment in reaching a result and assigning its probable error.

Discussion of the Equations.

But we scarcely enter upon the computation before we find the distribution of errors to be so different from that of the normal law that some modification of the method is necessary. The familiar method is to reject all observations, the residuals of which are so large as to indicate some abnormal sources of error, and to retain the others with unmodified weight. That this method is not the best one is very evident from the fact that it is necessary to assign some limit to the value of an error which can be regarded as normal, and that this limit is necessarily a matter of judgment. The final result then becomes a discontinuous function of the residual of the rejected observation, the continuity being broken at the point regarded as the limit of normal error. A simple example will make the case clear. If we have three observed results a, b, c, of which the mean

is to be taken, and if c be the result which may be abnormal, then so long as c is retained we shall have

$$\text{Mean} = \frac{1}{3}(a+b+c);$$

the mean will then continually increase with c. When c passes the normal limit the mean changes per saltum to

$$\frac{1}{2}(a+b).$$

If c_0 be the limit, we have two values differing by the amount

$$\frac{1}{6}(2c_0-a-b),$$

of which we choose either one or the other. As the limit of abnormality is necessarily doubtful, being very largely a matter of judgment, it follows that if c is near the limit c_0, we shall be in doubt which of the two values are to be adopted. The laws of probability show that the best result is a weighted mean of the two, the weights being proportional to their probabilities. This involves making a weight to be assigned to an observation depend upon its deviation from the mean of the other observations, a proceeding which seems to violate the logical rules of procedure in combining observations. But the method is logically rigorous if properly applied.

The subject was treated by the writer in a former publication[a] where a method was shown of making the weight a function of the residual error of the observation. The fundamental idea of the method is quite simple. In the formula of distribution of the errors under the normal law it is assumed that the modulus of error (instead of which we may use the probable error) is a perfectly determinate quantity. Clearly this can never be the case in practice. The modulus of error must itself always be a more or less doubtful quantity. We can never say in practice that the chance is less than 1 out of 200 that a residual will be five times the assigned probable error. In a rigorous treatment of the subject what we should do is to regard the modulus itself as a doubtful quantity and to determine the law of the probability that it shall have any one of its separate possible values. It is shown in the paper referred to how a weight can be assigned the value of which shall diminish with the residual error of the observation to which it is applied.

The strict application of the method would require two approximations, too laborious to be remunerative except in the simple taking of means. Even then the advantage of applying it is not so much the attainment of increased precision as the satisfaction of the investigator in reaching an unbiased result. But in this case there is a modification which leads to a result practically as good as that of the rigorous method, and much easier. It consists in assigning a limit to the value which an entirely abnormal error may have; but if a residual exceeds that limit instead of throwing the observation out entirely, we assign it a weight diminishing with the magnitude of the residual.

In the paper already alluded to I have developed the theory of the diminution of weight. This of course depends upon the distribution of the possible values of the modulus of error. So long as this modulus is absolutely fixed the weights are equal. They vary with the range of possible values of the modulus.

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[a] American Journal of Mathematics, Vol. VIII, p. 343.

So little is gained by aiming at complete rigor of method that almost any modification which will prevent the incongruity of changing the weight per saltum from 1 to 0 at a certain point will do. Almost any reasonable law of diminution will answer the purpose. In taking a simple mean, an easy method which will lead to a result practically as good as the most rigorous treatment is this:

We premise that up to a certain limit e_0 the weight of an observation should not be diminished on account of its discordance. The question will arise as to the law of diminution of the weight when the residual error exceeds e_0. In this case let us put for Δ the excess of the error above the limit e_0. Then I propose to determine the weight by the condition

$$w = \frac{e_0}{e_0 + \Delta}$$

This will lead to practically the same result as if we substituted for the actually observed quantity another quantity corresponding to the residual e_0. Instead of taking a mean by weights we change one of the quantities of which the mean is taken, and use the weight 1.

Of course there is still a certain amount of indetermination because the limit e_0 is a matter of judgment. But the influence of the judgment is far less than what results from continuing the usual fashion of treatment. Some observers throw out discordant observations much more freely than others, and they may still disagree as to the precise point where an observation is entitled to less weight; but their judgments will, in the latter case, differ much less than if the question were whether an observation should be rejected entirely or retained with full weight.

We shall still have to regard observations as quite abnormal, and reject them entirely, when the residuals are so large as to show some gross error. We then have an uncertainty which is in kind of the same general nature as that when the usual plan is adopted. But the doubt is reduced in two ways. In the first place the number of observations in which there can be any question of rejection or retention with diminished weight will be few. Moreover, the difference of the results, according to whether in these rare cases the observation is retained or rejected, will be small.

54. *Abbreviated method of solving the equations.*—Of the 8 unknown quantities which enter into the equations as written, 5 are to be regarded as increasing uniformly with the time. Thus in a rigorous treatment of the equations we should have to form normal equations in 13 unknown quantities, the labor of which would be great. I shall therefore adopt a method somewhat similar to that already applied in treating the equations of 1672–1747. Owing to the slowness of the change in most cases, it does not seem necessary to determine the most probable value in the way that we did in Chapter IX. What we shall do is first to determine the unknown quantities from the different groups of equations as they stand. We shall then develop the quantities thus determined in the form $a+bt$. In the earlier observations, especially those made before 1820, the number of observations in a group is so small that the probable error of the unknown quantity will be considerable. We must therefore proceed by adjustment and successive approximations, so as to reach as the final result what seems to be the most probable value of the unknown quantity with its secular variation.

In order to make the coefficients more homogeneous we have transformed several of the unknown quantities by multiplication by the factor 3; that is to say, we have taken, instead of the unknown quantity α_0 and δ_0, ⅓ of these unknowns.

Data for Normal Equations—Immersion.

	Unknown.	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	κ	+13.81	+14.18	+33.77	+80.88	+119.89	+109.41	+208.76	+371.00
ab	$i\theta$	+ 0.16	− 2.63	+ 0.86	+ 0.08	− 2.45	+ 1.14	− 3.57	+ 5.86
ac	i	− 1.12	+ 0.28	− 1.33	+ 3.59	− 8.58	+ 2.71	− 7.48	− 1.65
ad	b_0	+ 1.92	+ 3.81	+ 3.64	+ 2.26	− 4.21	+ 1.17	− 3.62	− 3.93
ae	$\frac{1}{3}\alpha_0$	+ 5.42	+ 4.33	+14.03	+31.20	+ 48.26	+ 33.97	+ 83.41	+136.24
af	$\frac{1}{3}\delta_0$	+ 0.44	+ 0.45	− 8.82	−25.10	− 14.30	− 25.74	− 11.31	+137.93
ag	ϵ	+ 2.59	+ 0.88	+ 2.11	+ 3.61	− 3.09	− 1.32	− 7.50	− 4.38
an	....	− 0.36	+16.77	+15.20	+29.43	+ 38.33	− 38.02	− 90.23	−131.55
bb	$i\theta$	+ 3.77	+10.83	+ 6.65	+21.10	+ 41.33	+ 49.97	+ 72.11	+132.19
bc	i	+ 0.57	− 0.41	+ 0.20	− 1.46	+ 3.05	+ 3.44	+ 0.09	+ 7.36
bd	b_0	− 0.76	− 3.44	+ 2.41	− 5.83	− 5.36	− 1.22	− 9.07	+ 11.99
be	$\frac{1}{3}\alpha_0$	+ 0.90	− 7.71	+ 1.20	− 5.89	− 3.93	− 9.36	− 9.20	− 32.41
bf	$\frac{1}{3}\delta_0$	− 1.41	− 2.11	+ 0.12	+ 3.60	− 3.28	+ 4.70	− 1.34	+ 0.15
bg	ϵ	+ 0.08	+ 0.42	− 0.30	+ 1.03	− 12.17	− 1.31	+ 2.43	+ 33.11
bn	....	+ 3.59	− 2.87	− 2.41	+ 2.60	+ 12.26	+ 1.54	+ 18.77	+103.38
cc	i	+ 4.95	+ 8.28	+ 7.69	+40.48	+ 50.74	+ 56.29	+109.12	+177.47
cd	b_0	+ 3.18	+ 3.28	− 3.57	− 2.92	− 2.04	+ 0.48	+ 1.29	+ 32.19
ce	$\frac{1}{3}\alpha_0$	+ 0.99	+ 2.37	− 2.07	+ 1.75	− 12.25	+ 3.04	+ 5.07	+ 3.43
cf	$\frac{1}{3}\delta_0$	− 0.87	− 1.30	+ 0.14	− 3.26	+ 3.67	+ 3.36	+ 1.45	+ 1.67
cg	ϵ	− 0.81	+ 1.78	− 3.19	− 4.14	− 4.05	− 5.62	− 21.29	+ 36.00
cn	....	− 0.93	+ 1.60	+ 0.83	− 0.91	− 13.60	− 17.78	− 35.28	− 8.76
dd	b_0	+ 8.82	+18.76	+14.27	+62.07	+ 92.04	+106.31	+181.51	+310.09
de	$\frac{1}{3}\alpha_0$	+ 1.69	+ 4.48	+ 5.48	+11.27	− 1.87	+ 20.56	+ 21.27	+ 23.91
df	$\frac{1}{3}\delta_0$	+ 1.27	− 4.35	+ 0.13	+ 5.15	+ 1.11	+ 6.02	+ 12.51	+ 3.20
dg	ϵ	+ 2.87	+ 5.09	+ 4.10	+21.57	+ 19.38	+ 18.60	+ 47.75	+112.87
dn	....	− 3.92	+ 5.27	+ 9.30	−19.76	− 41.17	− 63.15	− 80.71	−126.06
ee	$\frac{1}{3}\alpha_0$	+ 5.62	+22.97	+16.82	+56.08	+ 88.59	+106.70	+172.25	+294.42
ef	$\frac{1}{3}\delta_0$	− 2.12	+ 0.19	− 9.02	−17.31	− 9.42	− 8.38	− 28.07	+ 44.23
eg	ϵ	+ 1.87	+ 3.76	+ 3.20	+ 9.88	+ 4.30	+ 6.21	+ 6.31	− 14.14
en	....	− 3.04	− 6.28	+12.92	+ 8.82	+ 12.32	− 7.09	− 33.35	−114.77
ff	$\frac{1}{3}\delta_0$	+10.21	+24.29	+30.51	+76.12	+132.17	+106.35	+253.27	+467.03
fg	ϵ	+ 0.49	− 2.72	− 2.80	+ 0.35	+ 2.16	+ 0.74	+ 2.33	+ 3.51
fn	....	+ 0.80	+ 4.80	−10.96	− 2.66	− 24.19	+ 21.44	− 1.98	− 87.09
gg	ϵ	+ 6.38	+ 8.49	+ 8.70	+38.35	+ 55.66	+ 58.27	+110.77	+192.86
gn	....	− 2.95	+ 6.53	+ 9.24	+10.90	− 14.65	− 7.33	+ 22.90	+ 1.08

Marked correlation exists between several of the coefficients in these normal equations—notably between κ and α_0, and b_0 and ϵ. This will be considered a little later.

The above systems of equations were solved by the method of successive approximation. The resulting values of the unknowns are tabulated below:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ
	$''$	$''$	$''$	$''$	$''$	$''$	$''$
VI. 1753–1779	+0.41	+1.16	+0.02	−0.16	−0.93	+0.05	−0.29
VII. 1783–1801	+1.30	−0.66	+0.24	−0.20	−0.90	+0.22	+1.20
VIII. 1801–1820	+0.26	−0.62	+0.85	+0.53	+0.29	−0.12	+0.88
IX. 1821–1838	+0.40	−0.07	−0.04	−0.55	−0.02	+0.14	+0.56
X. 1839–1856	+0.30	+0.26	−0.27	−0.42	−0.08	−0.14	−0.04
XI. 1857–1873	−0.35	+0.07	−0.31	−0.64	+0.20	+0.19	+0.01
XII. 1874–1890	−0.49	+0.17	−0.29	−0.54	+0.12	+0.01	+0.34
XIII. 1891–1908	−0.29	+0.75	−0.03	−0.48	−0.12	−0.10	+0.13

Data for Normal Equations—Emersions.

	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	+6.59	+4.87	+10.16	+28.30	+50.27	+61.43	+110.03	+178.40
ab	−0.18	−0.33	+1.42	−1.32	+0.43	+1.31	−4.65	−4.16
ac	+0.83	+0.89	−1.13	−0.09	+0.81	−0.54	+3.23	+6.76
ad	+1.74	+0.77	+1.89	+3.41	+2.11	−1.42	−3.39	−3.66
ae	+2.12	+2.25	+5.48	+18.64	+16.49	+20.02	+45.61	+46.14
af	+2.34	+1.04	−3.32	−18.80	−1.54	−11.98	−1.69	+59.38
ag	+0.75	+0.29	+0.11	+3.89	+1.63	+2.12	+8.17	−2.27
an	+8.48	+6.87	−1.77	+16.21	+6.91	−4.98	−47.92	−83.58
bb	+1.34	+3.87	+3.09	+6.32	+11.83	+20.58	+29.79	+65.49
bc	+0.34	−0.51	−0.65	−0.91	+0.60	−0.10	−2.96	−0.34
bd	+0.82	+2.71	+2.09	−0.40	+5.00	−4.81	+1.89	+1.74
be	+0.59	−2.05	+0.89	−3.28	−3.59	−3.71	+1.87	−26.89
bf	+0.84	−0.15	+0.66	+0.87	+1.87	−1.01	+0.15	+2.13
bg	+0.42	+1.50	−0.55	−0.01	−4.18	−1.04	−0.44	+14.27
bn	−2.86	−0.89	−0.41	−4.75	+6.71	+5.55	+18.22	+53.00
cc	+1.23	+1.18	+3.89	+15.22	+22.32	+21.09	+57.39	+89.83
cd	+1.20	−0.93	−2.39	+1.70	−4.24	−2.77	−7.06	+16.79
ce	+0.72	+1.05	−1.37	+1.78	−4.85	−1.92	+11.57	+20.57
cf	+0.23	+0.35	+0.32	−1.91	−2.41	+0.77	−4.76	+3.69
cg	+0.19	−1.13	−2.57	+0.32	−2.25	+0.28	−9.35	+21.87
cn	−1.24	+1.52	−4.72	+9.36	−9.76	−5.03	−30.94	−12.41
dd	+2.60	+5.08	+7.09	+21.58	+34.27	+41.63	+87.82	+154.63
de	+1.26	−2.22	+4.08	+6.95	+4.72	+1.06	+12.90	+22.91
df	+0.59	+0.41	−2.92	−2.47	+4.16	+5.47	−8.17	+22.73
dg	+1.75	+3.36	+1.90	+11.71	+5.84	+9.42	+24.99	+45.85
dn	+0.07	+0.31	+1.91	+3.93	+0.44	+0.24	−29.77	−40.79
ee	+2.68	+4.38	+9.97	+29.55	+32.28	+35.78	+72.77	+144.68
ef	+1.20	+2.83	−5.69	−14.30	+0.94	−6.52	−12.96	+8.37
eg	+1.02	−0.52	+1.55	+5.78	+9.56	+7.37	+17.41	+13.21
en	−2.50	+5.57	−5.72	+3.84	−5.56	+0.32	−37.47	−39.42
ff	+3.86	+12.29	+11.90	+20.49	+52.13	+62.17	+97.17	+253.23
fg	+0.13	+0.30	+0.33	−2.13	−0.74	−0.88	−2.08	+3.97
fn	−3.41	+7.87	+4.24	−7.24	+7.64	+3.49	+7.65	−70.84
gg	+1.65	+4.14	+3.96	+12.78	+22.39	+26.96	+62.70	+92.63
gn	−1.43	−0.47	+3.13	−5.45	−19.43	+4.42	−57.09	−15.66

On account of their small weight, it is not worth while to solve Groups VI–VIII above. The results of the solution of Groups IX to XIII are exhibited below:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ
	″	″	″	″	″	″	″
IX. 1821–1838	+1.35	−0.66	+0.63	+0.86	−0.51	+0.58	−1.34
X. 1839–1856	+0.21	+0.23	−0.55	+0.06	−0.10	+0.11	−0.86
XI 1857–1873	−0.10	+0.30	−0.24	−0.02	+0.06	+0.06	+0.17
XII. 1874–1890	−0.38	+0.48	−0.69	−0.19	+0.09	+0.01	−0.91
XIII. 1891–1908	−0.42	+0.88	−0.04	−0.21	+0.11	−0.17	−0.21

Data for Normal Equations, Immersions and Emersions combined.

	Groups I–V. 1672–1746.	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	+40.86	+20.40	+19.05	+43.93	+109.18	+170.16	+170.84	+318.79	+549.40
ab	+ 1.15	− 0.02	− 2.30	+ 2.28	− 1.24	− 2.02	+ 2.45	− 8.22	+ 1.70
ac	.....	− 0.29	+ 1.17	− 2.46	+ 3.50	− 7.77	+ 2.17	− 4.25	− 5.11
ad	+ 0.10	+ 3.66	+ 4.58	+ 5.53	+ 5.67	− 2.10	− 0.25	− 7.01	− 7.59
ae	+12.61	+ 7.54	+ 6.58	+19.51	+ 49.84	+ 64.75	+ 53.99	+129.02	+182.38
af	+ 4.86	+ 2.78	+ 1.49	−12.14	− 43.90	− 15.84	− 37.72	− 13.00	+197.31
ag	− 0.21	+ 3.34	+ 1.17	− 2.22	− 7.50	+ 1.46	+ 0.80	+ 0.67	− 6.65
an	+23.96	+ 8.12	+23.64	− 2.82	+ 45.64	+ 45.24	− 43.00	−138.15	−215.13
bb	+14.62	+ 5.11	+14.70	+ 9.74	+ 27.42	+ 53.16	+ 70.55	+101.90	+197.68
bc	.....	+ 0.91	− 0.92	− 0.45	− 2.37	+ 3.65	+ 3.34	− 2.87	+ 7.02
bd	− 4.37	+ 0.06	− 0.73	+ 4.50	− 6.23	− 0.36	− 6.03	− 7.18	+ 13.73
be	− 1.55	+ 1.49	− 9.76	+ 2.09	− 9.17	− 7.42	− 13.07	− 7.33	− 59.30
bf	− 1.71	− 0.57	− 2.26	+ 0.78	+ 4.47	− 1.41	+ 3.69	− 1.19	+ 2.28
bg	− 6.34	+ 0.50	+ 1.92	− 0.85	+ 1.02	− 16.35	− 2.35	+ 1.99	+ 47.38
bn	−18.91	+ 0.73	− 3.76	− 2.82	− 2.15	+ 18.97	+ 7.09	+ 36.99	+156.38
cc	.....	+ 6.18	+ 9.46	+11.58	+ 55.70	+ 73.06	+ 77.38	+166.51	+267.30
cd	.....	+ 4.38	+ 2.35	− 5.96	− 1.22	− 6.28	− 2.29	− 5.77	+ 48.98
ce	.....	+ 1.71	+ 3.42	− 3.44	+ 3.53	− 17.10	+ 1.12	+ 16.64	+ 24.00
cf	.....	− 0.64	− 0.95	+ 0.46	− 5.17	+ 1.26	+ 4.13	− 3.31	+ 5.36
cg	.....	− 0.62	+ 0.65	− 5.76	− 3.82	− 6.30	− 5.34	− 30.64	+ 57.87
cn	.....	− 2.17	+ 3.12	− 3.89	+ 8.45	− 23.36	− 22.81	− 66.32	− 21.17
dd	+38.46	+11.42	+23.84	+21.36	+ 83.65	+126.31	+147.94	+269.33	+464.72
de	+ 4.90	+ 2.95	+ 2.26	+ 9.56	+ 18.22	+ 2.85	+ 21.62	+ 34.17	+ 46.82
df	+ 6.10	+ 1.86	− 3.94	− 2.79	+ 2.68	+ 5.27	+ 11.49	+ 4.34	+ 25.93
dg	+23.93	+ 4.62	+ 8.45	+ 6.00	+ 33.28	+ 25.22	+ 28.02	+ 72.74	+158.72
dn	+37.02	− 3.85	+ 5.58	+11.21	− 15.83	− 40.73	− 62.89	−110.48	−166.85
ee	+23.88	+ 8.30	+27.35	+26.79	+ 85.63	+120.87	+142.48	+245.02	+439.10
ef	− 2.93	− 0.92	+ 3.02	−14.71	− 31.61	− 8.48	− 14.90	− 41.03	+ 52.60
eg	+ 7.45	+ 2.89	+ 3.24	+ 4.75	+ 15.66	+ 13.86	+ 13.58	+ 23.72	− 0.93
en	+23.59	− 5.54	− 0.71	+ 7.20	+ 12.66	− 6.76	− 6.77	− 70.82	−154.19
ff	+32.34	+14.07	+36.58	+42.41	+ 96.61	+184.30	+168.52	+350.44	+720.26
fg	+ 3.11	+ 0.62	− 2.42	− 2.47	− 1.78	+ 1.42	− 0.14	+ 0.25	+ 7.48
fn	+ 7.68	− 2.61	+12.67	− 6.72	− 9.90	− 16.55	+ 24.93	+ 5.67	−157.93
gg	+25.58	+ 8.03	+12.63	+12.66	+ 51.13	+ 78.05	+ 85.23	+173.47	+285.49
gn	+23.75	− 4.38	+ 6.06	+12.37	+ 5.45	− 34.08	− 2.91	− 34.19	− 16.74

Method of Solving for the Unknown Corrections.

The following values have been adopted as a first approximation to the unknown quantities. They have been obtained by combining the values just given separately for the immersions and emersions. The weights assigned below have not been chosen on any uniform plan, the probable error for weight unity varying with the unknown to which it is attached.

Group.	Mean date.	T−1850.	κ	Wt.	$i\theta$	Wt.	i	Wt.	b_0	Wt.	$\frac{1}{3}\alpha_0$	Wt.	$\frac{1}{3}\delta_0$	Wt	ϵ	Wt.
			"		"		"		"		"		"		"	
I–V	1720	−1.30	+0.44	25	−1.03	9	....	...	....	...	+0.54	16	+0.12	25	+0.50	16
VI	1761	−0.89	+0.41	9	+1.16	4	+0.02	3	−0.16	5	−0.95	4	+0.05	9	−0.29	4
VII	1792	−0.58	+1.30	16	−0.66	9	+0.24	7	−0.20	15	−0.90	25	+0.22	25	+1.20	9
VIII	1811	−0.39	+0.26	25	−0.62	9	+0.85	6	+0.53	10	+0.29	16	−0.12	.25	+0.88	9
IX	1829	−0.21	+0.67	100	−0.18	25	+0.13	54	−0.16	70	−0.18	64	+0.23	100	+0.09	49
X	1848	−0.02	+0.27	100	+0.25	49	−0.35	68	−0.30	120	−0.09	100	−0.08	100	−0.28	64
XI	1865	+0.15	−0.26	100	+0.14	81	−0.29	75	−0.55	130	+0.17	100	+0.14	100	+0.06	81
XII	1882	+0.32	−0.45	100	+0.25	100	−0.42	160	−0.42	240	+0.11	100	+0.01	100	−0.14	100
XIII	1899	+0.49	−0.34	100	+0.79	100	−0.03	250	−0.38	400	−0.04	100	−0.13	100	0.00	100

From these values we have derived by a least square solution the correction to the adopted values of the elements for the epoch 1850, as well as the correction to the adopted centennial motions. The results of this solution follow:

$$\left.\begin{aligned}
\kappa &= +0\overset{\prime\prime}{.}07 - 0\overset{\prime\prime}{.}85\ (\mathrm{T}-1850)\\
i\theta &= +0.17 + 0.75\ (\mathrm{T}-1850)\\
i &= -0.17\\
b_0 &= -0.37\\
\tfrac{1}{3}\alpha_0 &= -0.03 + 0.13\ (\mathrm{T}-1850)\\
\tfrac{1}{3}\delta_0 &= +0.04 - 0.15\ (\mathrm{T}-1850)\\
\epsilon &= +0.05 - 0.33\ (\mathrm{T}-1850)
\end{aligned}\right\}(a)$$

It has been assumed that i and b_0 are constants. These values of the elements have been used as a first approximation in obtaining more correct values, in the following way: Take for instance the unknown $\sin i\ \delta\Omega$. The normal equation in $\sin i\ \delta\Omega$, which is the second equation in each group, is used as a basis of obtaining a second approximation to its value. It is first thrown into the form

$$y = \frac{[bn]}{[bb]} - \frac{[ab]}{[bb]}x - \frac{[ac]}{[bb]}z - \frac{[ad]}{[bb]}s \quad . \quad . \quad . \quad .$$

in which $y = \sin i\ \delta\Omega$. There are nine such equations in y, one corresponding to each group. As the coefficients $\frac{[ab]}{[bb]}, \frac{[ac]}{[bb]}$ . . . . are small fractions, we need only approximate values of $x, z, s,$ . . . . , in order to get a more accurate value of y. These values of $x, z, s,$ . . . . for this substitution are obtained from equations (a). In this manner all the unknowns have been solved anew with the following results:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ
	″	″	″	″	″	″	″
I–V	+0.64	−1.27	. . .	+0.56	+0.30	+0.03	+1.12
VI	+0.45	+0.20	+0.11	−0.66	−1.23	−0.35	−0.61
VII	+1.33	−0.28	+0.35	+0.08	−0.26	+0.29	+0.79
VIII	+0.42	−0.20	−0.38	+0.40	+0.12	−0.08	+1.03
IX	+0.50	−0.21	+0.14	−0.25	+0.11	−0.01	+0.33
X	+0.26	+0.39	−0.35	−0.34	−0.01	−0.07	−0.29
XI	−0.25	+0.08	−0.31	−0.42	+0.06	+0.15	+0.09
XII	−0.43	+0.32	−0.42	−0.39	−0.10	+0.01	−0.07
XIII	−0.39	+0.86	−0.02	−0.33	−0.09	−0.11	+0.08

From these values the following second approximation to the elements were obtained in the same manner as before:

$$\left.\begin{aligned}
\kappa &= +0\overset{\prime\prime}{.}06 - 0\overset{\prime\prime}{.}92(\mathrm{T}-1850)\\
i\theta &= +0.16 + 1.02(\mathrm{T}-1850)\\
i &= -0.18\\
b_0 &= -0.31\\
\tfrac{1}{3}\alpha_0 &= -0.02 - 0.08(\mathrm{T}-1850)\\
\tfrac{1}{3}\delta_0 &= 0.00 - 0.04(\mathrm{T}-1850)\\
\epsilon &= +0.14 - 0.50(\mathrm{T}-1850)
\end{aligned}\right\}(b)$$

Starting anew with the values (b), the solution was repeated in the same manner, with the following results:

Group.	Epoch.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ε
		"	"	"	"	"	"	"
I–V	1720	+0.58	−1.11	. ..	+0.32	+0.05	0.00	+0.91
VI	1761	+0.34	+0.10	+0.06	−0.78	−1.35	−0.38	−0.71
VII	1792	+1.24	−0.23	+0.25	−0.02	−0.34	+0.29	+0.71
VIII	1811	+0.34	−0.23	−0.25	+0.29	+0.02	−0.04	+0.95
IX	1829	+0.43	−0.17	+0.15	−0.25	+0.04	+0.01	+0.26
X	1848	+0.26	+0.42	−0.34	−0.36	−0.01	−0.07	−0.32
XI	1865	−0.24	+0.08	−0.31	−0.43	+0.05	+0.14	+0.07
XII	1882	−0.41	+0.32	−0.41	−0.39	−0.10	0.00	−0.08
XIII	1899	−0.36	+0.83	−0.03	−0.32	−0.06	−0.10	+0.04

These values lead to the following results for the correction to the elements for 1850 and their centennial motions with their probable errors:

$$\left.\begin{aligned}
\kappa &= +\,0.''04 \pm 0.''06 \\
&\qquad -(0.83 \pm 0.15)(T-1850) \\
i\theta &= +\,0.16 \pm 0.06 \\
&\qquad +(0.97 \pm 0.15)(T-1850) \\
i &= -\,0.18 \pm 0.19 \\
b_0 &= -\,0.32 \pm 0.14 \\
\tfrac{1}{3}\alpha_0 &= -\,0.05 \pm 0.04 \\
&\qquad +(0.07 \pm 0.10)(T-1850) \\
\tfrac{1}{3}\delta_0 &= \,0.00 \pm 0.03 \\
&\qquad -(0.04 \pm 0.07)(T-1850) \\
\varepsilon &= +\,0.09 \pm 0.07 \\
&\qquad -(0.40 \pm 0.16)(T-1850)
\end{aligned}\right\} \quad (c)$$

Correlation between the Unknowns.

Correlation between κ and α_0. The coefficient of α_0 is given by

$$\begin{aligned}\alpha_0 &= F \sin m' - \cos \delta \sin m_1 \\ &= \sin m' - \cos \delta \sin m_1 + 2\, e \cos g \sin m'.\end{aligned}$$

The coefficient of κ is $\cos g \sin m'$, a quantity which, according to the above equation, is seen to enter into α_0, forming in fact a large percentage of its numerical value.

Correlation between b_0 and ε. We have

$$\begin{aligned}\text{coeff. of } b_0 &= \cos m', \\ \text{“} \quad \text{“} \quad \varepsilon &= \cos m \sin L - \sin m \sin B \cos L.\end{aligned}$$

The second term of ε is small. But on account of the large number of occultations of the Pleiades which we have used in the above discussion, for which $\sin L$ is nearly unity, the value of the coefficient of ε has a preponderance toward the value $\cos m$. As this differs but little from the coefficient of b_0, correlation will exist between the quantities b_0 and ε, if determined as above. In order to separate the two, only those equations of condition should be used which belong to stars which are well distributed in longitude.

SECTION II.—FINAL SHAPING OF THE RESULTS.

55. As the methods we have followed in working out results differ in several important points from those ordinarily used it is necessary for the sake of clearness to outline the relation of the various processes. In determining the elements of motion in the solar system, especially the coordinates of the sun, moon, and planets, the conclusive method consists in adopting positions of the fixed stars which are derived from observation and, assuming these positions to be correct, to determine the right ascensions and declinations of the sun, moon, and planets. Sometimes the declinations of these bodies are determined as absolute without reference to the declinations of the stars and in other forms of reduction they depend upon the latter.

In the case of occultation of stars by the moon all the determinations are, of course, relative; the positions of the moon are therefore referred to positions of the stars, assumed to need no correction. In this way we work out a system of corrections to the moon's coordinates, or of individual positions of the moon's center relative to the occulted stars. Assuming the latter to be known, we thus derive a large mass of relative corrections by which the corrections to the lunar elements are determined.

These elements necessarily have to be revised as improved positions of the stars are determined. But the great point which we have to recall is that by conclusive methods the work of determining the final positions of the stars is quite independent of that of determining the positions of the moon. Following this method, our course would be to adopt the best set of star positions, probably those of Professor Boss, and, assuming them to be absolute, to determine values of the lunar elements which would be regarded as definitive. Substantially this is what we have done, only instead of Boss's fundamental positions we have used those worked out in my own fundamental catalogue of 1900. The difference is probably not of prime importance, and in any case, it need not be considered, because the new course we are now taking seeks to derive independent systematic corrections to the star places of the occultations themselves. The relations between these various corrections are first expressed in the form of equations of condition, the solution of which on various hypotheses may be supposed to lead eventually to the best double result.

We thus have been dealing with two sets of corrections to the moon's elements, in one of which the positions of the stars are regarded as given, while in the other set the star positions are corrected from the occultations themselves.

What has been said of positions of the stars applies equally to those of the sun. Heretofore whenever eclipses have been used it has been exclusively to determine positions of the moon, those of the sun being assumed as given by the solar tables. But when we inquire how the data of observation can best be used we find that the process should be reversed and that the positions of the sun, or rather its mean longitude, and possibly the other solar elements should be determined from the occultations.

The idea on which we have proceeded has been to determine the systematic corrections of the star positions from the occultations themselves. We should expect the absolute right ascensions of the stars in the general mean, as well as the position of the equator among the stars, to admit of better determination from the occultations than from the meridian observations, especially when the means of the corrections are considered, each correction being of the form:

$$a+bt.$$

The earlier meridian observations are quite uncertain and this uncertainty must affect greatly the values of b. Now, fairly good observations of occultations extend back to 1700, while good mean observations of star positions are few in number before the work at Greenwich and Poulkova in 1840–1850. In other words, we have a range of more than two centuries in the results from occultations as against less than three-quarters of a century for the meridian observations them-

selves. This being remarked, is in addition to the known systematic errors which affect even the best meridian observations of declination.

56. *Corrections of the lunar elements relative to the stars.*—Let us inquire what corrections to the lunar elements we should derive if the places of the stars were exact; also assuming these places to require corrections, what discordances we should expect to find by ignoring the errors of the star places. Assuming the star positions to be exact, the elements which we determine from the occultations are:

λ, the correction to the moon's mean longitude;

x, or $-2e\delta\pi$, the correction growing out of the lunar perigee;

i, the correction of the inclination;

$i\theta$, the correction of the node into the sine of the inclination.

We should also look for a common correction b_0 to all the latitudes of the moon. The values of λ then derived would be the same which we have already developed in the preceding chapter. The results for the other unknown quantities are obtained by several successive approximations to the unknown quantities, with the following results for the various groups.

Year.	Group.	κ	$i\theta$	i	b_0
		$''$	$''$	$''$	$''$
1720	I–V	+0.59	−1.48	. . .	+(0.83)
1766	VI	+0.40	+0.17	−0.09	− 0.53
1792	VII	+1.28	−0.20	+0.29	+ 0.11
1811	VIII	+0.35	−0.26	−0.42	+ 0.41
1830	IX	+0.45	−0.16	+0.14	− 0.21
1848	X	+0.25	+0.37	−0.35	− 0.33
1865	XI	−0.25	+0.09	−0.31	− 0.42
1882	XII	−0.43	+0.32	−0.41	− 0.41
1900	XIII	−0.39	−0.82	−0.05	− 0.37

By successive approximations we find that the unknown quantities developed in the form $a+bt$ are as follows. We count the time from 1850 as the most convenient fundamental epoch for our purpose.

$$-2e\delta\pi = +0''.04 - 0''.86\,(T-1850)$$
$$\sin i\delta\Omega = +0.13 + 1.06\,(T-1850)$$
$$\delta i = -0.19$$
$$b_0 = -0.36$$

The interpretation of the first three unknowns involves no difficulty. It is different in the case of the latitude correction, which may arise from several sources, and which will require a separate investigation to be placed on a satisfactory basis.

We recall that Hansen applied a common correction of $-1''.00$ to all the moon's latitudes, accounting for it on the ground that there might be a displacement of the center of gravity of the moon from its center of figure. We must regard the introduction of this quantity as one of the unfortunate features of Hansen's tables, especially as there are other causes than that introduced by Hansen for such a discrepancy. These are:

1. An error in the adopted constant of the lunar parallax. This would result in a common systematic correction to all the declinations, and therefore to all the latitudes of the moon observed on the meridian in the northern hemisphere. Of course the result would be reversed in the southern hemisphere, but Hansen did not make use of any observations in that hemisphere. I do not think that the theoretical value of the lunar parallax which we have derived from the terrestrial value of gravity is likely to be in error by more than $0''.1$. This may be regarded as the possible error of our correction to Hansen's parallax, which we have found to be $0''.40$ (§26).

2. The other cause of the constant latitude discrepancy would be found in the common error of the declinations or latitudes of all the occulted stars.

3. It may well be that the lunar inequalities in the outline of the moon's disk are more or less systematic in their character, thus producing an apparent systematic error in b_0. Really this is practically identical with Hansen's hypothesis of a displacement of the centers of gravity and figures, since the apparent center of figure is altered by the lunar inequalities.

In forming the equations of condition I have assumed a value of this third displacement in a direction at right angles to the moon's varying orbit. I think this is not what we should expect from the theory of libration, but am unable to correct the result at present. The best that we can do, therefore, seems to be to ignore this correction, or rather to merge it with the common corrections to the latitudes of all the stars.

It may be added in this connection that the general method we have adopted will completely suffice to determine both the systematic amount of the Hansen inequality and the common correction to the declinations of all the stars. In fact, the formulæ which we have derived in Chapter II for the coefficients of the equations of condition enable an independent determination of the quantities to be made. But there still seems to be some discrepancy which the author is, in completing the work, unable to explain.

Our next important result will be the common correction to the Right Ascensions and Declinations of all the stars. From the equations (c), page 219, this comes out

$$\alpha_0 = -0''.15 + 0''.21\ (T-1850),$$
$$\delta_0 = \ \ 0.00 - 0.12\ (T-1850).$$

I regard this correction to the equinox as probably more reliable than any heretofore obtained, so far at least as the centennial motion is concerned. As has already been explained it rests on the principle that the equinox can be determined from the moon as well as from the sun, while the probable error of the determination is much less. In the case of the equinoxes determined from the sun we have the unavoidable difficulties arising from the effect of the diurnal change of temperature on the instrument and the surroundings, and the uncertainty as to the personal equation of the observer. The latter is worthy of special consideration. Before the existence of the magnitude equation was known, it was necessarily assumed that there would be no personal equation between the observations of the sun and of a star. Now, if we suppose, as we might well do, that the personal equation is the same for the sun's limb and for a star of the first magnitude there would then be an equation of $0^s.05$ between the sun and a star of the seventh magnitude. We have assumed that the standard personal equation for magnitude corresponds to the magnitude 4.0, and this is the standard to which the preceding result alludes.

Our result, as derived from equations (c), may therefore be expressed in the following form: When the Right Ascensions are all reduced for magnitude equation to the standard magnitude 4.0 the correction for equinox is

$$\alpha_0 = -\ 0''.15 \pm 0''.12$$
$$+ (0.21 \pm 0.30)(T-1850).$$

Expressed in time the results are:

$$\alpha_0 = -\ 0^s.010 \pm 0^s.008$$
$$+ (0.014 \pm 0.020)\ (T-1850).$$

The apparent correction to the standard declination is yet smaller, which is surprising, because the general trend of evidence is that the standard adopted requires an appreciable correction. On this subject compare the catalogues of Boss and Auwers. On the other hand, we have to remember that the uncertainty arising from the figure of the moon can not be completely eliminated by the process we have followed and must, therefore, still affect this result.

SEC. III.—DEFINITIVE VALUES OF THE LUNAR ELEMENTS AS DERIVED FROM THIS INVESTIGATION.

For convenience of reference, the conclusions of the present paper as to the principal elements of the moon's motion will now be collected.

As different fundamental epochs are more convenient for different purposes we have chosen three, the comparison of which will serve as a check upon the values of the printed numbers. These epochs are:

1800, Jan. 0.0, G.M.N.; Julian date 2 378 497;
1850, Jan. 0.0, G.M.N.; Julian date 2 396 759;
1900, Jan. 0.0, G.M.N.; Julian date 2 415 021.

The time from these several epochs is counted in Julian centuries of 36525 days each.

T_0 means the time from 1800.0;
T_1 means the time from 1850.0;
T_2 means the time from 1900.0.

The epoch for $T=0$ is therefore indicated without ambiguity, depending on whether we use T_0, T_1, or T_2. I have always found this condensed method of expressing the time through long periods much more convenient than the ordinary method of using a fraction, dividing the years by 100 for centuries.

We have two sets of corrections designated as A and B. In the set A we have assumed the star places to be subject to corrections as shown below. In B the initial values are accepted without correction.

$$\left.\begin{aligned}
\delta\pi &= -\,0''.36 + 7''.55\,T_1\\
\delta\Omega &= +\,1.79 + 10.84\,T_1\\
\delta i &= -\,0.18\\
b_0 &= -\,0.32\\
\alpha_0 &= -\,0.15 + 0.21\,T_1\\
\delta_0 &= 0.00 - 0.12\,T_1\\
\delta\varepsilon &= +\,0.09 - 0.40\,T_1
\end{aligned}\right\}\text{A}$$

$$\left.\begin{aligned}
\delta\pi &= -\,0''.36 + 7''.83\,T_1\\
\delta\Omega &= +\,1.45 + 11.84\,T_1\\
\delta i &= -\,0.19\\
b_0 &= -\,0.36\\
\delta\varepsilon &= +\,0.09 - 0.43\,T_1
\end{aligned}\right\}\text{B}$$

The values of the moon's mean longitude, λ, longitude of perigee, π, and longitude of node, Ω, used by Hansen in his tables are given below. Hansen gives their values for the epoch 1800, Jan. 0.0 only. For convenience of reference their values for 1850, Jan. 0.0, and 1900, Jan. 0.0, are given in addition. The relation between λ, π, and Ω, and the quantities g, ω, and Ω, tabulated by Hansen, is well known and need not be stated here. Hansen uses:

$$\begin{aligned}
\lambda &= 335^\circ\ 43'\ 26''.70 + (1336^r + 1108\ 419''.61)\,T_0 + 13''.301\,T_0^2 + 0''.0135\,T_0^3\\
\pi &= 225\ \ 23\ \ 53.06 + (\ \ 11 + \ \ 392\ 582.46)\,T_0 - 36.134\,T_0^2 - 0.037\,T_0^3\\
\Omega &= \ \ 33\ \ 16\ \ 31.15 - (\ \ \ 5 + \ \ 482\ 939.61)\,T_0 + \ \ 8.189\,T_0^2 + 0.007\,T_0^3
\end{aligned}$$

$$\begin{aligned}
\lambda &= 123^\circ\ \ 5'\ \ 2''.31 + (1336^r + 1108\ 432''.92)\,T_1 + 13''.321\,T_1^2 + 0''.0135\,T_1^3\\
\pi &= \ \ 99\ \ 51\ \ 54.74 + (\ \ 11 + \ \ 392\ 546.30)\,T_1 - 36.190\,T_1^2 - 0.037\,T_1^3\\
\Omega &= 146\ \ 13\ \ 38.72 - (\ \ \ 5 + \ \ 482\ 931.41)\,T_1 + \ \ 8.200\,T_1^2 + 0.007\,T_1^3
\end{aligned}$$

$$
\begin{aligned}
\lambda &= 270^\circ\ 26'\ 45''.84 + (1336^r + 1108\ 446''.25)\ T_2 + 13''.341\ T_2^2 + 0''.0135\ T_2^3 \\
\pi &= 334\ \ 19\ \ 38.30 + (\ \ 11 + 392\ 510.08)\ T_2 - 36.245\ T_2^2 - 0.037\ \ T_2^3 \\
\Omega &= 259\ \ 10\ \ 50.38 - (\ \ \ 5 + 482\ 923.21)\ T_2 + \ 8.210\ T_2^2 + 0.007\ \ T_2^3
\end{aligned}
$$

The various corrections to Hansen which we have found will now be collected. These corrections are of the form:

$$a_0 + a_1 T + a_2 T^2 + a_3 T^3.$$

In Chapter IX, §47, we found:

$$
\begin{aligned}
\delta\pi &= -0''.97\ T_0^2 - 0''.0078\ T_0^3, \\
\delta\Omega &= -0.63\ T_0^2 + 0.0013\ T_0^3.
\end{aligned}
$$

Adding to these partial corrections the values obtained in solution (B) preceding, after reducing all of the corrections to the same epoch, and collecting the results, we obtain the results given below. The value of $\varDelta\lambda$ is taken from §51, and needs no explanation. The results for all three epochs are given for convenience.

$$
\begin{aligned}
\varDelta\lambda &= -\ \ 0''.31 - 26''.57\ T_0 - 4''.23\ T_0^2 - 0''.0067\ T_0^3; \\
\varDelta\pi &= -\ \ 4.27 + \ 7.82\ T_0 - 0.97\ T_0^2 - 0.0078\ T_0^3; \\
\varDelta\Omega &= -\ \ 4.47 + 11.84\ T_0 - 0.63\ T_0^2 + 0.0013\ T_0^3;
\end{aligned}
$$

$$
\begin{aligned}
\varDelta\lambda &= -14''.65 - 30''.81\ T_1 - 4''.24\ T_1^2 - 0''.0067\ T_1^3; \\
\varDelta\pi &= -\ \ 0.60 + \ 6.85\ T_1 - 0.98\ T_1^2 - 0.0078\ T_1^3; \\
\varDelta\Omega &= +\ \ 1.29 + 11.21\ T_1 - 0.63\ T_1^2 + 0.0013\ T_1^3;
\end{aligned}
$$

$$
\begin{aligned}
\varDelta\lambda &= -31''.12 - 35''.05\ T_2 - 4''.25\ T_2^2 - 0''.0067\ T_2^3; \\
\varDelta\pi &= +\ \ 2.57 + \ 5.86\ T_2 - 0.99\ T_2^2 - 0.0078\ T_2^3; \\
\varDelta\Omega &= +\ \ 6.74 + 10.58\ T_2 - 0.63\ T_2^2 + 0.0013\ T_2^3.
\end{aligned}
$$

The final adopted values of the mean longitude of the moon, the longitude of the perigee, and of its node now become for the chosen epochs:

$$
\begin{aligned}
\lambda &= 335^\circ\ 43'\ 26''.39 + (1336^r + 1108\ 393''.04) T_0 + \ 9''.07\ T_0^2 + 0''.0068\ T_0^3 \\
\pi &= 225\ \ 23\ \ 48.79 + (\ \ 11 + 392\ 590.28) T_0 - 37.10\ T_0^2 - 0.045\ \ T_0^3 \\
\Omega &= \ \ 33\ \ 16\ \ 26.68 - (\ \ \ 5 + 482\ 927.77) T_0 + \ 7.56\ T_0^2 + 0.008\ \ T_0^3
\end{aligned}
$$

$$
\begin{aligned}
\lambda &= 123^\circ\ \ 4'\ 47''.66 + (1336 + 1108\ 402.11) T_1 + \ 9''.08\ T_1^2 + 0''.0068\ T_1^3 \\
\pi &= \ \ 99\ \ 51\ \ 54.14 + (\ \ 11 + 392\ 553.15) T_1 - 37.17\ T_1^2 - 0.045\ \ T_1^3 \\
\Omega &= 146\ \ 13\ \ 40.01 - (\ \ \ 5 + 482\ 920.20) T_1 + \ 7.57\ T_1^2 + 0.008\ \ T_1^3
\end{aligned}
$$

$$
\begin{aligned}
\lambda &= 270^\circ\ 26'\ 14''.72 + (1336 + 1108\ 411.20) T_2 + \ 9''.09\ T_2^2 + 0''.0068\ T_2^3 \\
\pi &= 334\ \ 19\ \ 40.87 + (\ \ 11 + 392\ 515.94) T_2 - 37.24\ T_2^2 - 0.045\ \ T_2^3 \\
\Omega &= 259\ \ 10\ \ 57.12 - (\ \ \ 5 + 482\ 912.63) T_2 + \ 7.58\ T_2^2 + 0.008\ \ T_2^3
\end{aligned}
$$

Principal elliptic term in longitude (Cowell): $22{,}639''.50 \sin g$.
Principal term in latitude: $18{,}461''.45 \sin u$.

The mechanical ellipticity of the earth.—Subducting the precessional motions from the movement of π and ☊ in the values given above for the epoch 1850 we obtain the following values for the sidereal movements for a Julian year:

$$\pi_1 = +146\ 435''.29 \pm 0''.02,$$
$$☊_1 = -\ 69\ 679.45 \pm 0.02.$$

These values, taken in conjunction with their theoretical values deduced by Brown furnish a value of the terms in the lunar theory due to the ellipticity of the earth, and therefore the mechanical ellipticity itself, which is probably as accurate as any obtainable. The terms due to this cause as deduced from the occultations become

$$\delta\pi_1 = +6''.49t; \qquad \delta☊_1 = -6''.13t.$$

The theoretical values deduced by Hill are:

$$\delta\pi_1 = +6''.82t; \qquad \delta☊_1 = -6''.41t.$$

From the values of $\delta\pi_1$, we find that Hill's value of

$$\mu = \frac{3}{2}\frac{1}{M}\left(C - \frac{A+B}{2}\right) = 0.0017595,$$

which enters as a factor into all the perturbations due to the earth's ellipticity, should be multiplied by $F=0.952$ in order to represent its observed value. Similarly from the observed value of $\delta☊_1$, the factor is found to be $F=0.956$, which is in very good agreement with the preceding. A third value of equally great weight can be deduced by comparing Hill's value of the principal ellipticity term in latitude with its observed value. There is, however, a difficulty in obtaining its value from observation, due to its entering into the moon's latitude in the same manner as the obliquity of the ecliptic. The obliquity must therefore be assumed as known with precision from observations of the sun. Assuming Newcomb's value of the obliquity for 1850 as correct, we deduce from the set of corrections (*c*), page 219, the following correction to Hansen's value:

$$\varDelta\beta = +0''.09 \sin v.$$

Hansen used

$$\delta\beta = -8''.63 \sin v.$$

The observed value is, therefore,

$$\delta\beta = -8''.54 \sin v.$$

Subducting from this,

$$\delta\beta = -0''.23 \sin v,$$

due to the motion of the ecliptic and action of the planets, we obtain the following observed value of the principal term due to the earth's ellipticity:

$$\delta\beta = -8''.31 \sin v.$$

Hill's value is

$$\delta\beta = -8''.726 \sin v.$$

Comparison of these two values gives, therefore,

$$F = 0.952.$$

The agreement of these three entirely independent values of F which we have deduced, the total range in value being less than 1 per cent, is quite remarkable. Its mean value is

$$F=0.953.$$

The observed value of μ is, then,

$$\mu=0.001677.$$

There is no doubt that a better value for the observed principal inequality in latitude can be obtained after a rediscussion of solar observations, with especial reference to the obliquity of the ecliptic, has been made.

Addendum to Chapter XI.

Proceeding in regular course and assuming the theory to be complete, our final step in the present work would be to express the conclusions as to the values of the unknown quantities in terms of fundamental elements. But there are obstacles which prevent this being readily done. Among the most important of these elements is the factor depending upon the ellipticity and radius of gyration of the earth which determines the inequalities arising from the non-sphericity of the geoid. Hill determined the factor wholly by geodetic investigations, finding a markedly larger value than that derived by Helmert. But we may also determine the factor from the observed values of the several inequalities to which it gives rise. These are four in number:

1. The inequality in the moon's mean longitude depending on the longitude of the node.
2. The inequality in the moon's latitude produced by the same cause.
3. The motion of the node.
4. The motion of the perigee.

None of these four methods can be used to lead to a reliable result. The difficulty in the case of the longitude term in the ☊ arises from the irregular fluctuations in the moon's mean longitude, which make it impossible to separate these irregular changes from the regular inequality itself. In fact we shall find that, owing to this cause, the different values obtained for the coefficient of the ellipticity term are markedly discordant, the difference amounting to half a second or more.

The difficulty in the case of the latitude term is that practically it is combined with the obliquity of the ecliptic; that is to say, to determine it from observation we must have an independent knowledge of the obliquity. This, of course, we have, but not with a satisfactory degree of certainty. In other words, what we actually determine from observations of the moon is the value of $\varepsilon+\gamma$, the latter being the latitude coefficient. Having found this sum we have to subtract ε in order to obtain γ. Here we have an uncertainty of several tenths of a second owing to the difficulty of making an exact determination of the obliquity from observation. This difficulty is not encountered in the secular variation of the obliquity because the increment η is a constant. The value of $D_t\varepsilon$ which we have derived from our equations therefore correctly expresses the correction to the secular variation of ε because it seems to be the most reliable value of that variation with which observations supply us.

In the case of the node and perigee we have to make an exact theoretical determination of the secular motions of these two elements from pure theory, and assume that the excess of the observed motion over the theoretical one is due to the earth's ellipticity. From the rough determination I have made the result thus reached is fairly accordant with that reached in other ways, but it can not be called satisfactory.

In view of the reliability of the secular motion of the obliquity as we have derived it from occultations its magnitude may seem surprising; but there is an important action in play which may account for the discordance when fully investigated. This is the attraction of matter near the sun that causes the excess of motion of the perihelion of Mercury. The following is a

statement of the question as it now stands. In my final discussion of the solar elements (Elements and Constants), I found that the motion of the perihelion of Mercury could be caused by a ring of matter, either between Mercury and Venus or inside the orbit of Mercury itself. The latter, of course, will be so much the more probable that it alone need be considered.

Had it been certain that the motion was due to this cause, I might well have constructed the solar and planetary elements by introducing the hypothesis of this ring. As simplicity in the theory was a prime requisite, and the elements of the supposed ring were affected by such an uncertainty that I did not desire to see them made a basis of the theory of the sun, I therefore provisionally adopted the hypothesis that gravitation was not exactly as the inverse square, which had the advantage of great simplicity, leading, should it be wrong, to a very easy method of correcting the theory by future investigators.

After the publication of my tables, Brown's completed determination of the theoretical motion of the lunar perigee showed that the gravitation of the earth did not differ from the Newtonian law and the same thing was true presumptively of that of the sun. We were thus forced back upon the hypothesis of a mass of matter surrounding the sun sufficient to cause the motion of the perihelion of Mercury.

The next step forward was taken by Seeliger, who sought to identify the matter in question with that of the zodiacal light, and showed that by assuming an ellipsoidal mass the motion of the perihelion of Mercury and the other secular variations could be represented.

This hypothesis of Seeliger has been somewhat misapprehended. In its essential results it does not differ materially from my own hypothesis of an intramercurial ring. In fact, a comparison of Seeliger's elements with my ring elements will show a close approach to identity in the position of the plane containing the ellipsoidal mass.

More important yet is the fact that the matter of Seeliger's hypothesis is not really identical with that of the zodiacal light because it is too near the sun to be visible. In other words, nothing that we know of the figure of the zodiacal light would be compatible with Seeliger's ellipsoid. The latter is therefore to be regarded as an independent hypothesis, the matter of the zodiacal light not coming into play at all. At the same time I freely admit that the hypothesis of the ellipsoid is more probable than that of the ring, and therefore prefer Seeliger's form to my own.

We now reach a critical point in the whole discussion. All my determinations of the elements were made on the hypothesis that the motion of the perihelion of Mercury was not caused by the attraction of matter. Introduce this matter as an attracting body and we have a new set of secular variations, especially of the node of Venus. This may well be the reason why the value of the solar parallax which I derived from the node of Venus, notwithstanding its seeming certainty, is abnormally small.

It is therefore necessary to the completion of the results of the present paper that the secular motions of the elements, including the obliquity, be completely rediscussed.

CHAPTER XII.

DISCUSSION OF NARRATIVES OF ANCIENT ECLIPSES OF THE SUN.

SECTION I.

57. A total eclipse of the sun is so impressive a phenomenon, especially as presented to the minds of the ancients, who supposed celestial phenomena to be intimately associated with the destiny of men and nations, that the number of narratives of such eclipses found in ancient records seems notably small. Ginzel's charts show that between B. C. 700 and A. D. 200, 14 total eclipses of the sun were visible in Greece or its neighborhood and several others in regions outside of Greece where we should have supposed they would have been noticed and recorded by Greek or Roman historians. The number of annular eclipses is of course yet greater. Of these 30 or 40 striking eclipses only 5 have yet been identified with the narratives of historians, and in at least one of these cases the identification is doubtful. In this enumeration I have omitted several passages which have been supposed with a greater or less degree of probability to have referred to eclipses, but in which no identification is possible. Saying nothing of eclipses passing through more distant regions, which might well have been recorded, we find nine unrecorded total eclipses against four probably identified ones and one of doubtful identity.

The mass of literature relating to the subject of total eclipses during the period in question is so great that no detailed discussion and comparison of conclusions seems necessary in the present chapter. The author will therefore content himself with a résumé of the questions at issue.

He must admit at the outset that his views of the usefulness of the narratives in question as tests of the lunar tables may seem at first sight to differ so widely from those of nearly all other commentators as to require some explanation or defense. Naming only those authors who expressly or impliedly repose confidence in the results to be derived from the sources in question we have Hansen, Airy, Oppolzer, Ginzel, and Cowell, not to mention other writers who have touched on special points. So far as the author is concerned, it might at first sight seem that the authorities in favor of the material in question must far outweigh that of a single authority treating the material as practically valueless except for historic purposes. But, in order that the authorities may have weight as such, it is necessary that they should agree as to their conclusions. When we apply this test to their works we can scarcely be said to find agreement between any two, but rather conclusions of the most contradictory kind. An exceptional case of agreement may be that of Airy and Hansen; but their work had for its purpose rather to show that Hansen's tables represented the ancient eclipses than to derive any new conclusions from them. Ginzel and Oppolzer agree in deriving from the eclipses corrections to the elements of the mean moon's motion which are incompatible both with gravitational theory and with modern observations. So high are these authorities that if they agreed as to the corrections we might inquire whether greater weight should be assigned to modern observations than to the eclipses in question. But, as a matter of fact, we find no agreement as to the corrections which the modern tables require in order to represent the eclipses.

What the author now proposes to do is to repeat, so far as is necessary, his examination of ancient solar eclipses found in his Researches of 1878, in the light of more recent developments on the side both of observation and theory. The fundamental principles on which the treatment is based are so obvious as to need no detailed statement. The only fact of history on which any

conclusion can be based is that an identifiable total eclipse of the sun was seen to be total at a well-defined spot on the earth's surface. The mere fact of totality does not suffice unless the place where this phase was observed is established, nor does the place suffice unless the narrative inspires confidence that the total phase was actually observed at that place, and that the narrative does not refer to an observation of totality made elsewhere.

Granting that a narrative sustains this test, the next question to arise will be what conclusions are to be drawn from the fact of totality. In our ignorance of the time of the observed phase all that can be deduced from any one observation is an equation of condition between the corrections to the elements which will represent the phenomenon of totality. The question to be considered is, therefore, what elements we are to consider as subject to correction.

It needs no argument to show that the moon's mean longitude at the time is the most uncertain element, and therefore the one first to be considered. The mean motion is so well determined from modern observations that the correction to the mean longitude needs to be expressed only as that to the secular acceleration.

Next in order comes the correction to the longitude of the moon's node. The necessity of including this correction will depend upon whether we consider the longitude of the node to be sufficiently well determined from gravitational theory and modern observations. Formerly the uncertainty on this point was such that a correction to the node could well be included in the conditional equations. But at the present time it seems to me that, although it may be well to know what effect a change in the position of the node may have upon the phenomenon, we can scarcely correct its longitude by ancient eclipses, and this for the following reasons: The researches of Brown have shown that the motions of the perigee and node of the moon during the last 250 years are in as precise accordance with the Newtonian law of gravitation as the uncertainty of our data permits. Of the latter the ellipticity of the geoid is the principal uncertain element. The presumption is very strong that this accordance of the motion with the law of gravitation is a permanent feature of the moon's motion. Accepting this, it follows that the secular acceleration of these elements and, therefore, their values in ancient times, can be determined with all necessary precision by gravitational theory combined with modern observation. The actual centennial motion is to be determined from observations alone. The secular acceleration is easily determined by theory, as already shown.

The motion of the sun in longitude is now so well determined that it might appear quite superfluous to consider its correction by material so uncertain as that before us. But Mr. Cowell has sought to reconcile the most reliable ancient eclipses with gravitational theory and modern observation by assuming a secular acceleration of about 4″ in the sun's mean longitude. The probability of this need not be discussed in the present connection; but it is quite easy to include as an unknown quantity the correction to the sun's longitude in the conditional equations.

Proceeding as in former Researches we shall begin with a short study of the several narratives with a view of forming some idea beforehand how reliable each may be supposed. But it is not necessary to analyze critically the original passages, as was done in the former Researches.

58. (A) *Babylonian eclipse of* —*1062, June 19*.—For the account of this eclipse I depend upon Mr. Cowell's paper in the Monthly Notices R. A. S., Vol. LXV. We learn from this that Mr. L. W. King, of the British Museum, made a translation of a Babylonian record, reading as follows:

"On the 26th day of the month Sivan in the seventh year, the day was turned into night and fire in the midst of heaven."

Mr. Crommelin adds that the inscription from which this is an extract is a record of omens occurring in the city of Babylon—wild beasts entering the streets, dogs entering the temple, etc.

The author confesses his inability to see that this account should be considered as evidently referring to an eclipse of the sun, or if so, how it can be confidently regarded as having been total at Babylon. An unusual darkness from meteorological causes, popularly characterized as being

as dark as night, is more common than total eclipses of the sun. If the entrance of animals into the temple was an important omen, so might also be any unusual darkness. It also seems to me that, granting an eclipse of the sun, the critical care implied in not recording it unless it was absolutely total and omitting to take account of it if the statement regarding it was brought in by couriers from other regions, is not implied in what we know of the human mind in ancient times. "Fire in the midst of heaven" may well have been a description of the corona, but it may also have been suggested by other phenomena. It is also to be remarked that there is a range of half a century in the possible time of the occurrence. The year −1062 was chosen because it was the only one in which an eclipse could have been total near Babylon.

Under these circumstances it is well worth while to inquire whether, according to modern data, the eclipse could have been total at Babylon. If so, it will be admissible to inquire what correction to the moon's mean longitude is implied at that time.

(B) *Eclipse of Nineveh, −762, June 4.*—I quote the statement respecting this eclipse given by Mr. Cowell which, as translated from the inscription, is in the words: "In the month of Sivan the sun underwent an eclipse." I do not know how certain the identification of this eclipse is, but as the date seems to have been accepted by all who have alluded to the subject I assume that there is no doubt.

It is noteworthy that we have not the slightest intimation in the statement that the eclipse was total at Nineveh or anywhere else. The tables show that on the date assigned the shadow of the moon passed some two degrees north of Nineveh. In view of the rapid and constant intercommunication between different parts of the empire there can be no doubt that the fact of a total eclipse was reported at the capital and duly recorded. Under these circumstances I see no strong reason for assuming that the total phase passed over Nineveh, but rather the contrary, because in this case something would probably have been said about the darkness. In deference to the opinion of others on the subject, I shall, however, determine what changes in the lunar elements will bring the path south to Nineveh.

(C) *Eclipse of Archilochus, −647, April.*—In the writings of the poet Archilochus, who is supposed to have flourished some time in the seventh century B.C., is found the passage (Archilochus, frg. 74 [Bergk]):

Χρημάτων ἄελπτον οὐδέν ἐστιν οὐδ' απώμοτον οὐδὲ θαυμάσιον, ἐπειδὴ Ζεὺς πατὴρ 'Ολυμπιων ἔκ μεσημβρίης ἔθηκε νύκτ' ἀποκρύ ψας φάος ἡλίου· λάμποντος λυγρὸν δ' ἦλθ' ἐπ' ἀνθρώπους δέος.

I am indebted to Prof. Mitchell Carroll, of the George Washington University, for the following translation of the passage:

Of events not one is unexpected nor impossible nor wonderful, since Zeus, father of Olympus, out of high noon has made night, concealing the light of the shining sun; but baneful terror has come upon mortals.

From this it may fairly be inferred that Archilochus at some time in his life either witnessed a total eclipse of the sun or heard about one from those who had witnessed it. It may be supposed that the former is the more probable alternative, yet the presumption in favor of it is not strong. Of course, if he based his remarks upon the reports of others, no conclusion as to the path of totality could be drawn from what he says. Assuming that he was an eyewitness, the question is, where and when he made his observation. The only way in which the eclipse can be identified is by finding one which probably occurred during the early or middle life of the poet at the place where he lived.

So far as I have looked into the historical evidence, although it seems to be generally accepted that during several years of his life Archilochus lived on the island of Thasos, the doubt as to the date of his birth and death is such that we can not be at all confident that he lived on the island at the date in question. Even granting that he did, as Thasos is separated from the mainland by a strait only five miles in breadth, he might well have seen the eclipse as a nearly total one and heard of the totality from dwellers on the mainland. The presumption that the shadow actually

passed over Thasos is, therefore, rather weak, unless strengthened by coincidence with other eclipses.

The only eclipse that could have fulfilled the conditions is that of −647. Our conclusion must, therefore, rest on the following combination: (1) that the poet actually referred to a total eclipse of the sun; (2) that he saw the eclipse himself; (3) that he was living at the time on the island of Thasos. A possibility of some element in this combination failing is such that I have little confidence in any conclusion to be drawn from the eclipse.

(D) *Eclipse of Thales, −584, May 28.*—I have discussed the evidence for this celebrated eclipse with so much fullness in former researches[a] that nothing need be added on the lines there followed. Among other difficulties in using the eclipse was the obvious fact that if the change of day into night was really due solely to it, night must have been changed back into day almost immediately, a fact of which the historian says nothing, and the contrary of which is implied by the whole narrative. It is all the less necessary to rediscuss the question because all the difficulties in interpreting the narrative are cleared up by the computation of the shadow path from modern data which is found in the introduction to my paper on the recurrence of eclipses. The total phase came on some 15 or 20 minutes after sunset, a circumstance corresponding remarkably with the narrative of Herodotus. Moreover, as the total phase passed and the sun grew brighter, its continually increasing depression below the horizon might have made the seeming night almost permanent, and led to the result described by Herodotus. There can be little doubt that Thales predicted this eclipse; in fact, it is probable that this was the only one he could have predicted.

While these considerations seem to clear up the whole question, they leave it evident that no use can be made of the eclipse for correcting the astronomical tables.

(E) *Eclipses of −462 and −430.*—The first of these is one of the eclipses, the absence of which from recorded history may well appear remarkable. It is true that a passage in Valerius Maximus states that during the time of Pericles there was an eclipse of the sun which threw Athens into darkness and terrified the inhabitants. Their fear was allayed by Pericles, who explained the theories of Anaxagoras on the subject. But researches by Mr. Fotheringham[b] show that the eclipse must have been that of −430; in fact, it seems that Valerius Maximus really borrowed from Cicero in whose De Republica I, 16, we find the passage:

Atque eius modi quiddam etiam bello illo maximo, quod Athenienses et Lacedæmonii summa inter se contentione gesserunt, Pericles ille, et auctoritate et eloquentia et consilio princeps civitatis suæ, cum obscurato sole tenebræ factæ essent repente Atheniensiumque animos summus timor occupavisset, docuisse cives suos dicitur id quod ipse ab Anaxagora, cuius auditor fuerat, acceperat, certo illud tempore fieri et necessario, cum tota se luna sub orbem solis subiecisset; itaque, etsi non omni intermenstruo, tamen id fieri non posse certe nisi intermenstruo tempore. Quod cum disputando rationibusque docuisset, populum liberavit metu; erat enim tum hæc nova et ignota ratio, solem lunæ oppositu solere deficere quod Thaletem Milesium primum vidisse dicunt.

What is remarkable about this passage is that one would suppose that nothing but a total eclipse could have produced such fear among the Athenians. And yet the allusion to the Peloponnesian war, which did not commence until −431, seems to show with entire certainty that the eclipse alluded to is the annular one of −430, August 3, which is known as the eclipse of Athens, and which may well give rise to interesting discussion. The well known description by Thucydides II, 28, is translated as follows:

But in the same manner, at the new moon of the month, as in that time alone it seems possible for the phenomenon to occur—the sun was eclipsed after midday, and having assumed a crescent form, some of the stars having also appeared, it again became full orbed.

I believe that Thucydides has the reputation of being the most careful and exact of the Greek historians. He is writing of events of which he was a witness; he was in Athens at the time of

[a] Washington Observations for 1875, Appendix II; Astronomical Papers of the American Ephemeris, Vol. I.
[b] Observatory, December, 1908.

the eclipse, and it seems to be as certain as anything in his history can be that the eclipse alluded to is the one just mentioned.

Now, the curious fact is that according to the tables the eclipse was not total anywhere, but only annular, and the path of the annular eclipse passed centrally through the Black Sea some 200 miles from Athens, less than an hour before sunset, so that there was no time for the sun to have again become full-orbed before it set. But the fact that the stars are said to have appeared would indicate a total eclipse. It has been suggested by some writers that planets, especially Venus, might have been visible. As Venus can be easily seen within an hour of sunset, even when there is no eclipse, this would offer no difficulty except for the use of the plural. The starlike objects next brightest were Mercury and Mars, but I do not think that either of these could have been seen even during the annular phase.

From Mr. Fotheringham's study it appears that this eclipse must have been the one referred to by Cicero in terms so strong. It might therefore appear that the fact of totality at Athens is better made out than in the case of any other ancient eclipse seen at a definite point. This evidence is weakened only by the point that in his actual description Thucydides says nothing to indicate that the eclipse was total except his allusion to the stars, nor does he allude to any fear being among the inhabitants.

Still, it will be of great interest to determine what changes in the lunar elements would make this eclipse annular at Athens, and a further discussion of the subject may be deferred until we have made the comparison with the tables.

(F) *Eclipse of Agathocles, −309, August 14.*—This eclipse is completely identified with that observed by Agathocles, whose description would leave no reasonable doubt of totality. If any correction of the lunar elements could be based upon it, it would be the best of all the ancient ones for our purpose. But there are two circumstances which prevent this. In the first place, Agathocles was at sea and his position is doubtful. Secondly, the shadow path was so broad that even if we knew precisely where Agathocles was, no admissible changes in the tables would throw him outside the shadow unless he were near one border. Apart from this, the eclipse has been so thoroughly discussed by Airy and others that nothing more need be said of it in the present connection, although we shall have occasion to refer to it later.

(G) *Eclipse of Alexandria and the Hellespont, −128, November 20.*—This eclipse differs from all his others in that no date of the occurrence is recorded, but the circumstances of the eclipse are described with a degree of precision unequaled in any other ancient record. What is actually known is that the eclipse was total in the Hellespont and four-fifths covered at Alexandria. The three authorities by whom it is mentioned are cited and discussed with such fullness by Celoria[a] and later by Fotheringham[b] that it does not seem necessary to enter into details. Celoria undertook an exhaustive examination of all the eclipses within the period during which the eclipse in question might have occurred, basing his conclusions on Hansen's tables. The only one he found fulfilling the conditions was that of Agathocles, in −309. Afterwards Doctor Hultsch proposed to identify it with the eclipse of −128, November 20.

A careful examination showed that the eclipse was probably used by Hipparchus, and therefore occurred during the time of his activity. This renders the date last mentioned the only admissible one. We may therefore say with more confidence than in the case of any other central eclipse of antiquity that the eclipse of −128, November 20, was total in the Hellespont, while the sun was only four-fifths covered at Alexandria.

(H) *Eclipse of Utica, 197, June 3.*—We quote the following passage of Tertullian, at Scapian, chapter 3, from Mr. Cowell:

> Nam et sol ille in conventu Uticensi, extincto pæne lumine, adeo portentum fuit, ut non potuerit ex ordinario deliquio hoc pati, positus in suo hypsomate et domicilio. Habetis astrologos.

[a] Memorie della Classe di scienze fisiche, matematiche e naturali, Serie 3, Vol. VII, R. Accademia dei Lincei. Seduta del 7 marzo, 1880.
[b] Monthly Notices, R. A. S., Vol. LXIX, p. 204, January, 1909.

The tables show this eclipse to have been really annular though almost total. As Tertullian describes the eclipse only as nearly total, "extincto pæne lumine," there is a wide range of uncertainty as to the formation of the annulus. Any correction that can be derived from it will therefore be doubtful.

Possible Total Eclipses of Doubtful Identity.

59. There are a number of passages in the classical authors which may be supposed with more or less probability to have referred to total solar eclipses, which, however, prove incapable of certain identification. One of the most curious of these is the supposed eclipse of Xerxes, of which the time and place would seem to be more certainly fixed than in the case of any other. The place was near Sardis, the time between −477 and −480. What is remarkable is that the eclipse is described by two writers, both practically contemporaneous with the event.

Herodotus states that the sun, leaving his seat in the heavens, was concealed from view, and night instead of day came on, though the weather was not cloudy, but exceedingly clear.

Aristides states that there happened an eclipse of the sun in the east, which foretold to Xerxes his defeat, because the sun was eclipsed in the region of its rising, the direction from which Xerxes was marching.

No possible eclipse of the sun could have given rise to these two statements. The latter are therefore available only as an index to the degree of confidence with which we can assign any precise interpretation to the statements of ancient historians on the subject. It is quite unnecessary for our present purpose to discuss the numerous suggestions as to what the passages may have referred, because in any case the eclipse will be useless for our purpose.

A supposed eclipse at Larissa has been made celebrated through its discussion by Airy, who assigns the date −556. The author is Xenophon. Nothing but doubt has been thrown upon the whole subject of this eclipse by recent researches, which is heightened by the doubt whether the passage referred to an eclipse at all, and, if it did, whether the year −556 is possible.

The several other narratives quoted by Hansen to support his value of the secular acceleration it does not seem necessary to discuss, since they have been discussed at great extent by several recent authors without any result being reached on which a definite correction can be based.

The question may still arise as to the possible value of mediæval total eclipses. Ginzel has collected a great number of observations of this class, and Celoria, in a well-known paper, has discussed those of 1140 and 1143. What is especially worthy in this discussion is that the limits of the shadow path are determined from the statements of observers by judging in each case whether the eclipse was or was not seen as a total one.

Comparison with the tables shows that no admissible values of the elements of the moon's mean motion will give the limits of the path as mapped by Celoria.

The author has also made a careful study of Ginzel's eclipses with a view to determining whether in any case it could be judged with a fair degree of confidence that what any of the narrators saw was undoubtedly the total phase. If he found any such cases, they were too few to base any conclusions upon. He frankly admits that on this point he differs widely from the views of his fellow astronomers who have examined the same data, especially of Ginzel. The corrections derived by the latter from the totality of the mediæval eclipses as found in his Kanon der Finsternisse diverge greatly from the results of modern observations. Notwithstanding the high authority of so careful a student, the writer feels himself compelled to hold that when the question is whether the modern observations of Greenwich and Paris are in error by large fractions of a minute of time, or whether deductions from the narratives of mediæval authorities are reliable when we attempt to interpret them with entire precision, his own judgment is in favor of the modern observations, combined with gravitational theory. That the results of each author were widely divergent both from mean observations and gravitational theory, was not, it seems to me, given its due weight.

The maps of Oppolzer's Canon are defective principally from the rough method of delineating the path of central eclipse upon the earth. This was done by computing the noon point, and that of beginning and ending, and then drawing an arc of a circle upon the map through these three points. As the true path when projected upon the map scarcely ever approximates to the arc of a circle, the result is that although the noon point and the two extremes are correct according to the formulæ used, the intermediate portions of the path are frequently in error by 400 or 500 miles. This error might have been reduced by the very slight modification of computing the direction of the tangent to the path at the noon point, and then representing the path before and after this point by arcs of circles tangent to the actual path at the noon point. Although the path would not even then have been precise, it would have been much nearer the truth than is the one actually drawn.

In Ginzel's maps this defect does not exist, every path being laid down with entire precision according to his tabular elements.

SECTION II. DISCUSSION OF OPPOLZER'S TABLES OF ECLIPSES.

60. To compare ancient eclipses with theory, I have made use of Oppolzer's eclipse tables, applying the corrections necessary to reduce their elements to those of the concluded theory. These tables are constructed on a very convenient plan worked out by Hansen. They include only the larger inequalities in the motion of the moon and omit the periodic inequalities of the sun's longitude. The effect of these omissions on the circumstances of an eclipse is too small to be of importance in the discussion of the historical eclipses. The principal points in the construction of these tables are the following:

1. The moment of mean conjunction of the sun and moon in ecliptic longitude is tabulated.

2. The arguments with which the tables are entered have the values corresponding to this moment of mean conjunction, and are therefore readily computed and checked.

3. The theory is so constructed and transformed that the quantities tabulated are the reductions to the moment of true conjunction in longitude, and the values of the principal eclipse elements for the latter moment.

4. With the elements thus determined the circumstances of the eclipse are computed in the usual way, assuming the motions during the eclipse to remain unchanged from their value at true conjunction.

5. The elements tabulated on this system are ecliptical, not equatorial; some reductions to the equator are therefore necessary. The method of making this reduction is given at some length by Oppolzer, but I have found it more convenient to reduce the ecliptical coordinates of the axis of the shadow to the equator, thus using the Besselian coordinates in the further computations.

6. Oppolzer tabulates certain empirical corrections to his arguments, but does not, so far as the writer is aware, give any statement of the grounds on which they are based. As they are inconsistent both with gravitational theory and modern observations, I have ignored them, and reduced the elements to the concluded theory of the present work.

Correction of Oppolzer's Tables.

61. The elements on which Oppolzer's tables are based are Hansen's tables of the moon and Leverrier's of the sun. But the lunar elements of mean motion have received the following modifications:

The longitude of the node receives the correction

$$\Delta\Omega = -5''.5 + 11''.0\,T.$$

The lunar perigee remaining unchanged, Oppolzers's virtual correction of ω is

$$\Delta\omega = +5''.5 - 11''.0\,T.$$

2. The secular accelerations which Oppolzer adopts are those of Hansen's Darlegung, which compare with those of Hansen's tables as follows:

Hansen's Tables.	Oppolzer (Darlegung).	Oppolzer—Tables.
$''$ $''$	$''$ $''$	$''$ $''$
$\Delta_2 g = +49.435T^2+0.05007T^3$	$+51.134T^2+.05115T^3$	$+1.699T^2+.00108T^3$
$\Delta_2\omega = -44.323T^2-0.04376T^3$	$-45.200T^2-.04521T^3$	$-0.877T^2-.00145T^3$
$\Delta_2\Omega = +\ 8.189T^2+0.00716T^3$	$+\ 7.744T^2+.00662T^3$	$-0.445T^2-.00054T^3$
$\Delta_2\lambda = +13.301T^2+0.01347T^3$	$+13.678T^2+.01256T^3$	$+0.377T^2-.00091T^3$

The corrections required are those to Oppolzer. I accept his centennial motions of π and Ω, and therefore of ω, for the epoch 1800, but correct the terms in T^2 and T^3. These terms as corrected compare with those of Oppolzer as follows:

N.	N—O.
$''$ $''$	$''$ $''$
$\Delta_2 g = +46.171T^2+.0518T^3$	$-4.963T^2+.0006T^3$
$\Delta_2\omega = -44.66\ T^2-.053T^3$	$+0.540T^2-.0078T^3$
$\Delta_2\Omega = +\ 7.56\ T^2+.008T^3$	$-0.184T^2+.0014T^3$
$\Delta_2\lambda = +\ 9.071T^2+.0068T^3$	$-4.607T^2-.0058T^3$

These corrections are applicable to the body of Oppolzer's tables. They affect only the times of mean conjunction and the arguments with which the tables are entered.

The corrections of the arguments are of two classes, the one that of the moving elements at any given time; the other the reduction to the actual time of true conjunction in longitude.

The term in T of reduction of Oppolzer's mean longitude of the moon to that of the present theory is the same as for Hansen's tables. The entire reduction, N—O, is,

$$\delta\lambda = -0''.3 - 26''.57T - 4''.607T^2 - 0''.0058T^3.$$

In my new Tables of the Sun for 1900, Leverrier's mean longitude has received the correction

$$\delta L = -0''.36 - 0''.78T - 0''.018T^2.$$

Thus we have, for the correction to Oppolzer, $\lambda - L$,

$$\delta(\lambda - L) = -25''.79T - 4''.589T^2 - 0''.0058T^3.$$

We now put τ for the time of mean conjunction, called T by Oppolzer. Then $\Delta\tau$ is the time required for $\lambda - L$ to move through the arc $\delta(\lambda - L)$. Putting λ_1 and L_1 for the daily motions of λ and L, we have

$$\Delta\tau = \frac{\delta L - \delta\lambda}{\lambda_1 - L_1}.$$

We have

$$\lambda_1 = 13^\circ.176,$$
$$L_1 = \ 0^\circ.986.$$

Hence,

$$\Delta\tau = \frac{25''.79T + 4''.589T^2 + 0''.0058T^3}{12^\circ.190},$$

and

$$10^4\Delta\tau = 5.^d877T + 1^d.0458T^2 + 0^d.0013T^3.$$

The arguments of the tables are all given for the moment of mean conjunction. Their corrections therefore consist of two parts:

1. The correction at a given moment, as already found.
2. The reduction for the interval $\Delta\tau$.

We represent these two corrections by the symbols δ and δ_1.

Since Hansen's centennial motion of the perigee is retained without change, the term of g factored by T is the same as for λ. We therefore have for the correction of g,

$$\delta g = -26''.57\mathrm{T} - 4''.963\mathrm{T}^2 + 0''.0006\mathrm{T}^3.$$

In degrees

$$10^4\delta g = -73^\circ.80\mathrm{T} - 13^\circ.786\mathrm{T}^2 + 0^\circ.0017\mathrm{T}^3.$$

For the sun's mean longitude

$$10^4\delta L = -2^\circ.17\mathrm{T} - 0^\circ.050\mathrm{T}^2.$$

For the sun's mean anomaly Oppolzer used Leverrier's value

$$g' = g'_0 + (100^r - 3401''.40)\mathrm{T} - 0''.7157\mathrm{T}^2.$$

The value in my Tables of the Sun is

$$g' = g'_0 + (100^r - 3419''.86)\mathrm{T} - 0''.50\mathrm{T}^2.$$

Dropping the constant term for 1800 the result is:

$$\delta g' = -18''.46\mathrm{T} + 0''.22\mathrm{T}^2,$$

giving

$$10^4\delta g' = -51^\circ.3\mathrm{T} + 0^\circ.61\mathrm{T}^2.$$

Oppolzer's motion for the node for 1900 being also retained, we have

$$10^4\delta\Omega = -0^\circ.51\mathrm{T}^2 + 0^\circ.004\mathrm{T}^3$$
$$10^4\delta\omega = +1^\circ.50\mathrm{T}^2 - 0^\circ.021\mathrm{T}^3.$$

For the corresponding reductions for $\Delta\tau$ we have the daily motions

$$\begin{aligned} g_1 &= \overset{\circ}{13.065}, \\ g'_1 = L_1 &= 0.9856, \\ \omega_1 &= 0.1644, \\ \Omega_1 &= -0.0530. \end{aligned}$$

The product of these into $\Delta\tau$ gives the following:

$$\begin{aligned} 10^4\delta_1 g &= +\overset{\circ}{76.78}\mathrm{T} + \overset{\circ}{13.666}\mathrm{T}^2 + \overset{\circ}{0.0144}\mathrm{T}^3, \\ 10^4\delta_1 L &= +\ 5.792\mathrm{T} + \ 1.031\mathrm{T}^2 + 0.0011\mathrm{T}^3, \\ 10^4\delta_1\omega &= +\ 0.966\mathrm{T} + \ 0.172\mathrm{T}^2 + 0.0002\mathrm{T}^3, \\ 10^4\delta_1\Omega &= -\ 0.312\mathrm{T} - \ 0.056\mathrm{T}^2, \\ \delta_1 g' &= \delta_1 L. \end{aligned}$$

Adding these to the values of δg, etc., we have the entire corrections:

$$\begin{aligned} 10^4\Delta g &= +\ \overset{\circ}{2.98}\mathrm{T} - \overset{\circ}{0.120}\mathrm{T}^2 + \overset{\circ}{0.016}\mathrm{T}^3, \\ 10^4\Delta L &= +\ 3.62\mathrm{T} + 0.981\mathrm{T}^2 + 0.001\mathrm{T}^3, \\ 10^4\Delta\omega &= +\ 0.97\mathrm{T} + 1.67\mathrm{T}^2 - 0.021\mathrm{T}^3, \\ 10^4\Delta\Omega &= -\ 0.31\mathrm{T} - 0.57\mathrm{T}^2 + 0.004\mathrm{T}^3, \\ 10^4\Delta g' &= -45.51\mathrm{T} + 1.64\mathrm{T}^2 + 0.001\mathrm{T}^3. \end{aligned}$$

The corrections to Oppolzer's P and Q are each equal to that of $g+\omega$. Hence

$$10^4\Delta P = 10^4\Delta Q = +3^\circ.95\mathrm{T} + 1^\circ.55\mathrm{T}^2 - 0^\circ.005\mathrm{T}^3.$$

Oppolzer's arguments I–VIII are expressed in units of $0^\circ.9$. The expressions for the arguments and corrections thus arising are:

$$
\begin{array}{rll}
\text{Arg. I}=g & 10^4\Delta\text{I} & =+\overset{\circ}{3.3}T-\overset{\circ}{0.13}T^2+\overset{\circ}{0.018}T^3 \\
\text{II}=g' & 10^4\Delta\text{II} & =-50.6T+1.82T^2 \\
\text{III}=2g'+2\omega' & 10^4\Delta\text{III} & =+\ 8.0T+2.2T^2 \\
\text{IV}=g-g' & 10^4\Delta\text{IV} & =+53.9T-2.0T^2 \\
\text{V}=g+g' & 10^4\Delta\text{V} & =-47.3T+1.7T^2 \\
\text{VI}=\Omega & 10^4\Delta\text{VI} & =-\ 0.3T-0.6T^2 \\
\text{VII}=2g-g' & 10^4\Delta\text{VII} & =+57.2T-2.1T^2 \\
\text{VIII}=2g+g' & 10^4\Delta\text{VIII} & =-44.0T+1.6T^2
\end{array}
$$

These corrections are to be used in place of the "Empirische Correctionen," which Oppolzer prefixes to his tables. They are so readily computed that the exhibit of the following values, for intervals of 500 years, will answer our present purpose.

Year	T	$\Delta\tau$	ΔL	$\Delta P=\Delta Q$	ΔI	ΔII	ΔIII	ΔIV	ΔV
		d	°	°	°	°	°	°	°
−1200	−30	+0.0795	+0.080	+0.117	−0.07	+0.31	+0.2	−0.3	+0.3
− 700	−25	+0.0524	+0.054	+0.081	−0.05	+0.24	+0.1	−0.3	+0.2
− 200	−20	+0.0310	+0.033	+0.051	−0.03	+0.17	+0.1	−0.2	+0.2
+ 300	−15	+0.0151	+0.017	+0.028	−0.01	+0.12	0.0	−0.1	+0.1
800	−10	+0.0047	+0.006	+0.011	−0.01	+0.07	0.0	−0.1	+0.1
1300	− 5	−0.0004	−0.001	+0.002	0.00	+0.03	0.0	0.0	0.0
1800	0	0.0000	0.000	0.000	0.00	0.00	0.0	0.0	0.0

The corrections to the other arguments seem to be unimportant.

Theoretical precision requires that the secular variation of the earth's eccentricity be reduced to the modern value. Leverrier's value for 1850 is $-8''.755$. The modern value is $-8''.595$. The numbers factored by τ in Oppolzer's tables should therefore be diminished by 0.0183 of their amount. The effect of this correction has been omitted in the work. The maximum effect on τ for the ancient eclipses is $0^d.0002$.

62. It may be of interest to compare the preceding with Oppolzer's empirical corrections, as given on his pages 15 and [4] and [5]. His $\Delta\tau$ agrees closely with my own, being in my notation,

$$10^4\Delta\tau=+6^dT+0^d.9T^2+0^d.0009T^3.$$

This corresponds to

$$\Delta\lambda=-26''T-3''.9T^2-0''.0039T^3.$$

His $\Delta L'$, as tabulated, is the reduction of L' for $\Delta\tau$, or what I term $\delta_1 L$. As my δL is small, this differs little from my value.

The case is different with Δg and $\Delta\omega$. The values of these quantities cited by Oppolzer on his page 15 may be written

$$
\begin{aligned}
10^4\Delta(g+\omega)&=-190^\circ T-\ 4^\circ T^2-0^\circ.004T^3,\\
10^4\Delta g\quad &=\qquad\qquad +30^\circ T^2+0^\circ.03\ T^3,
\end{aligned}
$$

from which follows

$$10^4\Delta\omega=-190^\circ T-34^\circ T^2-0^\circ.034T^3.$$

But when we compare the result of computation with these expressions with Oppolzer's tabulated corrections we find that, while $\Delta(g+\omega)$ agrees and gives ΔP and ΔQ, as it should, this is not exactly the case with Δ Arg. I, the equivalent of g. The expression in sexigesimal degrees,

in fact, is used as centesimal degrees, without division by 0.9. It follows that, so far as results are concerned, the tabulated correction is

$$10^4 \Delta g = 27^\circ.0\mathrm{T}^2 + 0^\circ.027\mathrm{T}^3,$$

which will give

$$10^4 \Delta\omega = -190^\circ\mathrm{T} - 31^\circ.0\mathrm{T}^2 - 0^\circ.03\mathrm{T}^3.$$

These corrections are those for the mean conjunction. To pass from them to the actual corrections at a given time we have the relation

$$\delta = \Delta - \delta_1.$$

Using Oppolzer's $\Delta\tau$ we shall have

$$\begin{aligned} 10^4\delta_1 g &= +78^\circ.4\mathrm{T} + 11^\circ.76\mathrm{T}^2 + 0^\circ.012\mathrm{T}^3, \\ 10^4\delta_1\omega &= +\ \ 1^\circ.0\mathrm{T} +\ \ 0^\circ.15\mathrm{T}^2. \end{aligned}$$

It follows that the implicit values of the corrections are

$$\begin{aligned} 10^4\delta g &= -\ \ 78^\circ.4\mathrm{T} + 15^\circ.24\mathrm{T}^2 + 0^\circ.015\mathrm{T}^3, \\ 10^4\delta\omega &= -191^\circ.0\mathrm{T} - 31^\circ.15\mathrm{T}^2 - 0^\circ.03\ \mathrm{T}^3. \end{aligned}$$

Reducing to seconds of arc

$$\begin{aligned} \delta g &= -28''.22\mathrm{T} +\ \ 5''.486\mathrm{T}^2 + 0''.0054\mathrm{T}^3, \\ \delta\omega &= -68''.76\mathrm{T} - 11''.214\mathrm{T}^2 - 0''.0108\mathrm{T}^3, \\ \delta(g+\omega) &= -96''.98\mathrm{T} -\ \ 5''.728\mathrm{T}^2 - 0''.0054\mathrm{T}^3. \end{aligned}$$

The next question of interest is what corrections of the mean longitude, perigee, and node these imply. We have already found from $\Delta\tau$

$$\delta\lambda = -26''\mathrm{T} - 3''.9\mathrm{T}^2 - 0''.0039\mathrm{T}^3.$$

The argument g being that for the equation of the center is virtually $\lambda - \pi$. Hence

$$\delta\pi = \delta\lambda - \delta g.$$

The virtual longitude of the node is determined by the mean argument of latitude, $g+\omega$, through the condition

$$g + \omega = \lambda - \Omega.$$

Hence, for the virtual correction of the node

$$\delta\Omega = \delta\lambda - \delta(g+\omega) = \delta\pi - \delta\omega.$$

We thus have, for the perigee and node,

$$\begin{aligned} \delta\pi &= +\ \ 2''.22\mathrm{T} - 9''.39\mathrm{T}^2 - 0''.0093\mathrm{T}^3, \\ \delta\Omega &= +70''.98\mathrm{T} + 1''.82\mathrm{T}^2 + 0''.0015\mathrm{T}^3. \end{aligned}$$

These are the corrections which in Oppolzer's Canon der Finsternisse are implicitly applied to obtain the basis of the tables already quoted. To reduce them to the provisional basis of the present work they are equivalent to

$$\text{Newcomb} - \text{Opp. Can.:}\ \begin{aligned} \delta g &= +\ \ 1''.65\mathrm{T} - 10''.449\mathrm{T}^2 - 0''.0048\mathrm{T}^3, \\ \delta\pi &= -\ \ 2''.2\ \mathrm{T} +\ \ 9''.75\ \mathrm{T}^2 + 0''.003\ \mathrm{T}^3, \\ \delta\Omega &= -71''.0\ \mathrm{T} -\ \ 2''.00\ \mathrm{T}^2 - 0''.000\ \mathrm{T}^3. \end{aligned}$$

Ginzel's Empirical Corrections.

63. In his work (Spezieller Kanon der Finsternisse, p. 5), Ginzel gives a system of corrections with which he replaces those of Oppolzer. Changing the notation and form to that of the present work, they are:

$$10^4 \varDelta\tau = -1^d.92T + 0^d.247T^2 + 0^d.00025T^3.$$

This gives for the corresponding correction to the difference of mean longitude of the moon and sun

$$\varDelta\lambda - \varDelta L = 8''.43T - 1''.084T^2 - 0.0011T^3.$$

He also uses

$$10^4 \varDelta P = 10^4 \varDelta Q = -76^\circ.9T + 0^\circ.49T^2 + 0^\circ.00049T^3,$$
$$10^4 \varDelta I = +240^\circ T + 5^\circ.2T^2 + 0^\circ.0052\,T^3.$$

His values of $\varDelta L'$ and $\varDelta$III need not be used.

From $\varDelta\tau$ we have

$$10^4\,\delta_1 g = -\ 25^\circ.08T + 3^\circ.227T^2 + 0^\circ.00327T^3,$$
$$10^4 \varDelta g = +216^\circ.00T + 4^\circ.680T^2 + 0^\circ.00468T^3,$$
$$10^4\,\delta g = +241^\circ.08T + 1^\circ.453T^2 + 0^\circ.00141T^3,$$
$$\delta g = +\ 86''.79T + 0''.523T^2 + 0''.00051T^3.$$

This gives

$$\varDelta\pi = -78''.4T - 1''.61T^2 - 0''.0016T^3.$$

We also have

$$10^4\delta_1\,(g+\omega) = -25^\circ.4T + 3^\circ.26T^2 + 0^\circ.0033T^3.$$

Subtracting this from $\varDelta P = \varDelta(g+\omega)$, after multiplying $\varDelta P$ by 0.9, leaves

$$10^4\delta\,(g+\omega) = -43^\circ.8T - 2^\circ.82T^2 - 0^\circ.0029T^3,$$
$$\delta\,(g+\omega) = -15''.8T - 1''.02T^2 - 0''.0010T^3.$$

Whence, subtracting δg

$$10^4\delta\omega = -284^\circ.9T - 4^\circ.27T^2 - 0^\circ.0043T^3,$$
$$\delta\omega = -102''.6T - 1''.54T^2 - 0''.0015T^3,$$
$$\delta\Omega = +\ 24''.2T - 0''.07T^2 - 0''.0001T^3.$$

For the differences, Ginzel–Oppolzer, we have

$$\delta\Omega = -46''.8T - 1''.89T^2 - 0''.0016T^3,$$
$$10^4\varDelta\tau = -\ 7^d.9T - 0^d.65T^2 - 0^d.0006T^3.$$

Section III.—Computation of Eclipses from Oppolzer's Tables.

64. The computation of the principal circumstances of eclipses at any period of history can be so easily made by means of Oppolzer's tables with the application of the preceding corrections that it seems desirable to outline the best method of doing this. We begin by recalling to mind the basis of the theory of eclipses. This is a system of coordinates the planes of which pass through the center of the earth as the origin. The fundamental plane of $x\,y$ is perpendicular to the shadow axis. The axis of z is therefore parallel to the shadow axis, but only an approximate value of it is ever necessary. On the fundamental plane two systems of rectangular axes may be taken. In one, the axis of the equatorial system is the intersection of the equator with the plane. In the ecliptic system this axis is the intersection of the ecliptic with the plane. The first is the Besselian, the second the Hansenian system. We shall put

x_2, y_2, the coordinates of the shadow axis in the ecliptic system;
x, y, the coordinates in the Besselian system;
h, the angle between the axes of x in the two systems.

We now show how we may pass from the elements of the eclipse as found from Oppolzer's tables to the coordinates just defined. These elements are the following:

T, the moment of true conjunction of the sun and moon in longitude which we suppose expressed in Greenwich mean time;

L', the true longitude of the sun at this moment;

E, the equation of time, in the sense mean time = true time + E;

ε, the obliquity of the ecliptic;

P, the moon's argument of latitude at the time;

Q, p, q, auxiliary quantities which need not be geometrically defined, of which the first differs little from P, while p differs little from $\sin i \div \sin \pi$, and q differs little from $\sin i$, i being the inclination of the moon's orbit;

$\varDelta L'$, the hourly motion of the coordinate x_2 of the shadow axis along the fundamental plane.

When we seek the limits of the shadow of the penumbra two additional quantities are necessary, namely—

u, the radius of the umbra on the fundamental plane;

f, the angle which the element of the shadow cone makes with the shadow axis.

There will, of course, be two values of f as well as of u, the one corresponding to the penumbra, the other to the umbra.

These elements are computed from Oppolzer's tables and corrected by the formulæ already given.

The ecliptical coordinates of the shadow axis at the time T in terms of the Oppolzer elements are

$$x_2^{(0)}=0, \quad y_2^{(0)}=p \sin P. \tag{1}$$

The hourly motions of these coordinates, which we regard as constant, are

$$x_2'=\varDelta L',$$
$$y_2'=q \cos Q.$$

Their values at any time $T+t$ are

$$x_2=x_2't,$$
$$y_2=y_2^{(0)}+y_2't.$$

The method now proposed differs from that of Oppolzer in that these ecliptical coordinates are at once transformed to the Besselian system, which is used in the rest of the computation. For this transformation we need the sun's declination and the angle between the two systems of coordinate axes on the fundamental plane. These are computed by the formulæ

$$\left.\begin{aligned} \cos d \sin h &= \sin \varepsilon \cos L', \\ \cos d \cos h &= \cos \varepsilon, \\ \sin d &= \sin \varepsilon \sin L'. \end{aligned}\right\} \tag{2}$$

If the time of the special phase to be computed differs much from T, it may be well to correct L', the sun's longitude, for the motion during the interval. The effect of this correction will, however, always be small.

In strictness the angle d should be the declination of the shadow axis and not of the sun itself, but as the two are coincident at the total phase, which is the one principally considered, and differ very little in any case, we may use the declination of the sun for d throughout. The coordinates of the shadow axis are now reduced to those of the equatorial system by the equations

$$\left.\begin{aligned} x &= x_2 \cos h - y_2 \sin h, \\ y &= x_2 \sin h + y_2 \cos h. \end{aligned}\right\} \tag{3}$$

The hourly motions may be found by using the numerical values of x_2' and y_2' in these equations. A familiar form of computation is the following:

$$\left.\begin{aligned} m \sin \mathrm{M} &= x_2, & n \sin \mathrm{N} &= x_2', \\ m \cos \mathrm{M} &= y_2, & n \cos \mathrm{N} &= y_2', \\ x &= m \sin (\mathrm{M}-h), & x' &= n \sin (\mathrm{N}-h), \\ y &= m \cos (\mathrm{M}-h), & y' &= n \cos (\mathrm{N}-h). \end{aligned}\right\} \tag{4}$$

When, as will nearly always be the case in historical eclipses, we wish to find the circumstances of the eclipse, especially the magnitude of the greatest phase at a given place, our method of proceeding is this: we choose a moment τ expressed in Greenwich mean time as near as convenient to the moment of maximum phase at the place. The preceding computation of the coördinates may advantageously be made for this moment. For this moment we find the local west hour angle of the shadow axis by the equation

$$\mu' = \tau \times 15° - E + \lambda, \tag{5}$$

λ being the east longitude of the place from Greenwich. The coordinates ξ and η of the place of observation, together with their hourly motions, are found from the equations

$$\left.\begin{aligned} \xi &= \rho \cos \varphi' \sin \mu', \\ \eta &= \rho \sin \varphi' \cos d - \rho \cos \varphi' \sin d \cos \mu', \\ \xi' &= [9.4192]\ \rho \cos \varphi' \cos \mu', \\ \eta' &= [9.4192]\ \xi \sin d, \end{aligned}\right\} \tag{6}$$

where ρ and φ' are the radius of the earth and the geocentric latitude of the place.

We assume that the moment τ is so near the time of greatest phase that the hourly motions ξ' and η' may be regarded as constant during the interval. The least distance of the shadow axis from the place of observation, which we call $\varDelta$, is then given by the computation

$$\left.\begin{aligned} X &= x - \xi, & X' &= x' - \xi', \\ Y &= y - \eta, & Y' &= y' - \eta', \\ & & \varDelta = \frac{X'Y - XY'}{\sqrt{X'^2 + Y'^2}}. \end{aligned}\right\} \tag{7}$$

Here, of course, X and Y are the coordinates of the shadow axis relative to the point of observation.

The following form of computation may be used with advantage, especially as the values of s and S are used in computing the differential coefficients:

$$\left.\begin{aligned} c \sin \mathrm{C} &= Y, \\ c \cos \mathrm{C} &= X, \\ s \sin \mathrm{S} &= Y', \\ s \cos \mathrm{S} &= X', \\ \varDelta &= c \sin (\mathrm{C}-\mathrm{S}). \end{aligned}\right\} \tag{8}$$

A positive value of $\varDelta$ indicates that the shadow axis passes north of the place, and a negative value, that it passes to the south.

65. We have next to determine the displacement by a small change in the elements. Practically, it will suffice to determine the displacement in a direction parallel on the fundamental plane, which will be equal to $\delta\varDelta$. Now

$$\delta\varDelta = \frac{d\varDelta}{dX}\delta X + \frac{d\varDelta}{dY}\delta Y = -\sin \mathrm{S}\, \delta X + \cos \mathrm{S}\, \delta Y. \tag{9}$$

From the equations (3) we find

$$\left.\begin{aligned}\delta x&=\cos h\,\delta x_2-\sin h\,\delta y_2,\\ \delta y&=\sin h\,\delta x_2+\cos h\,\delta y_2.\end{aligned}\right\}\qquad(10)$$

The expressions for x_2 and y_2 in terms of the lunar and solar coordinates at a fixed moment are

$$\left.\begin{aligned}x_2&=\frac{\sin(v-L')}{\sin(\pi-\pi')},\\ y_2&=\frac{\sin\beta}{\sin(\pi-\pi')}=\frac{\sin i\sin(v-\Omega)}{\sin(\pi-\pi')},\end{aligned}\right\}\qquad(11)$$

where i is the inclination of the moon's orbit, and π and π' the parallaxes of the moon and sun, respectively.

In our present problem approximate values of the increments will suffice, so that we may put $\cos(v-\Omega)$ equal to ± 1 according to the node at which the eclipse occurs, and $\cos(v-L')$ equal to ± 1 according to whether it is a solar or a lunar eclipse. We may also take for v indifferently the longitude in orbit of the moon or its ecliptic longitude. Thus we may use for a solar eclipse

$$\left.\begin{aligned}\delta x_2&=\frac{\delta v-\delta L'}{\sin(\pi-\pi')},\\ \delta y_2&=\pm\frac{\sin i}{\sin(\pi-\pi')}(\delta v-\delta\Omega).\end{aligned}\right\}\qquad(12)$$

The substitution of these values in (10) gives δx and δy.

Since Δ is a function of $x-\xi$ and $y-\eta$ we have in rigor to subtract $\delta\xi$ and $\delta\eta$ from δx and δy. But we see from a comparison of (6) and (12) that $\delta\xi$ and $\delta\eta$ are less than δx and δy in the ratio $\sin\pi : 1$; we may therefore drop them entirely. We may then use instead of (10)

$$\begin{aligned}\sin(\pi-\pi')\delta X&=\cos h\,(\delta v-\delta L')\mp\sin h\sin i\,(\delta v-\delta\Omega),\\ \sin(\pi-\pi')\delta Y&=\sin h\,(\delta v-\delta L')\pm\cos h\sin i\,(\delta v-\delta\Omega).\end{aligned}$$

By substituting in (9) we see that the partial derivatives of Δ as to v, L' and Ω may be written

$$\left.\begin{aligned}\frac{d\Delta}{dv}&=\frac{\sin(h-S)}{\sin(\pi-\pi')}\pm\frac{\cos(h-S)}{\sin(\pi-\pi')}\sin i,\\ \frac{d\Delta}{dL'}&=-\frac{\sin(h-S)}{\sin(\pi-\pi')},\\ \frac{d\Delta}{d\Omega}&=\mp\frac{\cos(h-S)}{\sin(\pi-\pi')}\sin i;\end{aligned}\right\}\qquad(13)$$

the upper sign being used for an eclipse near the ascending node and the lower sign for one near the descending node.

To use the corrections of the mean longitudes of the sun and moon, as we should in theory, we multiply $\frac{d\Delta}{dL'}$ by $1+0.034\cos g'$, and $\frac{d\Delta}{dv}$ by $\frac{dv}{d\lambda}$, for which last we may put, in the case of a solar eclipse

$$\frac{dv}{d\lambda}=1.019+0.131\cos g.\qquad(14)$$

The increment of Δ in terms of increments to the moon's and sun's mean longitude, and Ω, the node, will then be

$$\delta\Delta=\frac{d\Delta}{dv}\frac{dv}{d\lambda}\delta\lambda+(1+0.034\cos g')\frac{d\Delta}{dL'}\delta L+\frac{d\Delta}{d\Omega}\delta\Omega,$$

the factors having the values given in (13) and (14).

Limits of the Umbra.

66. To determine from observation the position of a geographical point relative to the axis of the shadow at the moment of nearest approach, it is generally necessary to make use of the duration of the total phase at some point near the limit of the penumbra. We have therefore to determine the radius of the umbra at the place. For this we require angle f, which the elements of the umbral cone make with the axes, and in connection therewith the radius of the umbra on the fundamental plane. This branch of the theory of the eclipse is so familiar that no detailed development of the theory is necessary. The theory, so far as we have to make use of it, is rendered all the simpler from the fact that what we require is not the geographical limit of the shadow path on the earth's surface, but only the position of the place relative to the umbral cone at the moment of the nearest approach.

The angle f differs but little from the apparent semidiameter, s', of the sun. For the mean value of s' we use that which I have adopted in my Tables of the Sun, in which the effect of irradiation is subducted. This value is

$$s'_0 = 959''.63.$$

The sun's apparent semidiameter is, therefore,

$$s' = \frac{a'}{r'} \times 959''.63.$$

For the moon's constant of semidiameter I have found

$$s_0 = 932''.58.$$

Taking 8″.80 as the constant of solar parallax, the well known formula for the angle f may be reduced to the following approximate form:

Put f_1 for the umbral angle, and f_2 for the penumbral angle, although we shall scarcely have occasion to use the latter in our present work. Dropping terms of the order e'^2 we shall have:

$$f_1 = 957''.23(1.0026 + e' \cos g'),$$
$$f_2 = 962''.03(1.0026 + e' \cos g'),$$

where e' is the eccentricity of the earth's orbit and g' the sun's mean anomaly. If a more precise value is desirable, it may be found by the equations

$$\text{Umbra} \qquad f_1 = \frac{957''.23}{r' - .00258},$$

$$\text{Penumbra} \qquad f_2 = \frac{962''.03}{r' - .00258},$$

where r' is the sun's radius vector expressed in the usual way.

In Oppolzer's tables are given the formulæ for the radius on the fundamental plane, while the numerical value of the penumbral radius is tabulated for each eclipse in his Canon. But the enlarged semidiameters of the sun and moon, as affected by irradiation, have evidently been used in these formulæ.

The rigorous formula for the radius of the umbra on the fundamental plane is

$$u = k \sec f_1 - z \tan f_1,$$

where z is the perpendicular distance of the moon's center from the fundamental plane, expressed in terms of the earth's equatorial radius, while k is the linear radius of the moon. If the exact

value of z is wanted, which it is only in exceptional cases, it may be found with sufficient precision by the formula

$$z=\frac{\cos G}{\sin \pi},$$

G being the geocentric angular distance of the centers of the sun and moon at the moment of the phase under consideration.

For our purpose the umbral radius required is that upon a plane passing through the place, parallel to the fundamental plane. The distance of these two planes is the coordinate ζ corresponding to the formulæ (6) of which the value is

$$\zeta=\rho \sin \varphi' \sin d+\rho \cos \varphi' \cos d \cos \mu';$$

the required umbral radius is then

$$u_1=u+\zeta \tan f_1.$$

Should the penumbral radius also be required, this expression is

$$u_2=u'-\zeta \tan f_2.$$

The distance of the place from the margin of the shadow cone at the moment of greatest obscuration is then equal to

$$u_1-\varDelta.$$

If this difference comes out negative, it shows that according to the tables the eclipse was not entirely total at the place.

Ancient Eclipses—Numerical Results.

67. The results of the whole computation are tabulated as follows: T, L', etc., are the elements from the author's theory, in Oppolzer's notation. $\varDelta$ is given in units of the fourth place of decimals of the earth's equatorial radius. Each $\varDelta$ is followed by the increment which it would receive from an increment of λ, ☊, and L', all, for convenience, expressed in minutes of arc.

Elements of Seven Ancient Eclipses.

T			L'	E	P	Q	log p	log q	log $\varDelta L$
			°	°	°	°			
−1062	July	30.7548	116.332	+0.11	177.858	175.90	0.7005	8.7490	9.7528
− 762	June	4.8691	74.585	−2.08	176.547	174.74	0.6988	8.7509	9.7555
− 647	Apr.	5.8765	8.925	+0.75	171.597	172.14	0.6909	8.7594	9.7638
− 430	Aug.	3.1327	124.487	+0.52	170.577	172.95	0.7233	8.7262	9.7277
− 309	Aug.	14.8505	136.573	+0.52	3.736	2.66	0.6929	8.7574	9.7612
− 128	Nov.	20.0565	236.080	−2.79	9.403	11.40	0.6998	8.7490	9.7509
+ 197	June	2.9958	71.068	−1.61	1.702	4.03	0.7245	8.7249	9.7268

Node.	Date.			Minimum distance of shadow-axis.				Radius of shadow.
☋	−1062	July	30	$\varDelta=+516$	$-16.2\varDelta\lambda$	$+15.0\varDelta$☊	$-0.3\varDelta L'$	+ 94
☋	− 762	June	15	+684	− 3.3	+14.8	−11.9	+151
☋	− 647	Apr.	6	+567	−25.7	+14.6	+ 7.7	+178
☋	− 430	Aug.	3	+577	+23.4	+15.3	−38.7	− 55
☊	− 309	Aug.	14	−227	− 7.9	−14.6	+21.5	+145
☊	− 128	Nov.	20	+018	−20.9	−14.7	+33.6	+ 15
☊	+ 197	June	3	−436	−14.3	−15.6	+30.0	− 6

The preceding eclipses, that of -128 excepted, were discussed by Mr. Cowell. He shows that five of the eclipses in question can all be represented in two ways, either by a change in the secular acceleration of the node, or by a hitherto unsuspected acceleration of the sun's longitude, combined with an equal correction to the moon's secular acceleration.

It will be seen that the preceding equations are confirmatory of Mr. Cowell's results. A diminution of $36'$ in the longitude of the node will make all five of the eclipses nearly or quite annular or total, as the case may be. This effect will be brought about by a diminution of about $3''.5$ in the secular acceleration of the node.

In the equations it will be seen that the sums of the coefficients of the increments are nearly evanescent. It follows that the representation of the eclipses will remain nearly unchanged when we assign arbitrary equal increments to the longitudes of the moon, the sun, and the node. Hence, instead of a diminution of $3''.5$ in the nodal acceleration, we may assign an increment of $3''.5$ to the accelerations of the sun and moon. All this is quite accordant with Cowell's conclusions.

On the other hand, Cowell's corrections make both the eclipse of -309 and that of -128 only partial in the Hellespont. We have therefore to set against the evidence of the five the contrary evidence afforded by the eclipse of -128 that the elements admit of no correction.

It may also be remarked that an increase of $1''$ in the secular acceleration of the mean longitude, coupled with a diminution of $1''$ in that of the node, would suffice to make the eclipses of -1062 and -647 total, without throwing that of -128 quite away from the Hellespont. But this change in $\Delta^2\Omega$ is outside the limit of theoretical uncertainty, and in $\Delta^2\lambda$ is difficult to admit.

The question whether the remarkable coincidence among the five eclipses affords probable evidence that either set of corrections to the elements is real is one on which opinions will doubtless differ. It must certainly be admitted that either correction seems extremely improbable. In the case of the node, gravitational theory admits of no appreciable correction to the adopted secular acceleration. That any other cause than gravitation changes the motion of the node is rendered improbable by the close agreement between the actual motion and the theoretical motion derived by Brown.

Equally difficult of explanation on any theory is a secular acceleration of the earth's orbital motion. Moreover, while modern observations, so far as I have discussed them, do not exclude the possibility of such an acceleration, they do render it improbable.

The other branch of the question is, whether a chance coincidence in five cases out of six can be regarded as conclusive. The evidence in favor of the actual centrality at the several places of record of the eclipses, as the accounts are cited by Mr. Cowell, seems to me rather weak. It is certain that the eclipses were central within a few hundred miles of the several points, but, in the absence of any specific statement of the place, I see nothing stronger than a greater or less presumption of centrality at the supposed places.

The eclipse of the list in which the question of the phase is most perplexing is that of -430, described by Thucydides, and also mentioned by Cicero and Valerius Maximus, as seen at Athens. Both of these accounts are weak from proving too much, namely, a total eclipse. If there could be any question whether the eclipse was annular or total, the combined weight of the two accounts would lead us to regard totality at Athens as practically certain, because no other phase could have been one of darkness, caused alarm among the citizens, or made the stars visible. We must therefore make a large allowance for exaggeration; and the question is whether this allowance can be much smaller for an annular eclipse than for the partial eclipse which is computed from the tables. The most exact basis for a comparison is afforded by comparing the fraction of the sun's disk which must have remained uncovered in the two hypothetical cases. I find that if the eclipse was annular at Athens, the breadth of the annulus was about $18''$. If it were partial, a rough computation shows that the area of the sun's disk uncovered was about four times that of the annulus—

possibly nearly five times. At first sight this difference might seem important, but a little consideration may lead us to minimize this importance. The difference in the intensity of daylight under a cloudy sky may well be much greater than this without being striking. The light of the sky a very few minutes after sunset is less than it was during either of the hypothetical phases. Those who have observed total eclipses of the sun know how little striking is the apparent diminution in the intensity of daylight up to within a few minutes of the total phase, and how suddenly the first ray of the reappearing sun illumines the sky and blots out the stars. Computation shows that Venus was very favorably situated for observation during the eclipse of -430, and it may well be doubted whether any other star or planet could have been visible, even if the phase were annular. It is also to be considered that the ratio of the illuminations of the sky in the two cases is less than that of the uncovered sun. Altogether, we may make an ample allowance for exaggeration and misapprehension without overstepping the bounds of reasonable probability.

Chapter XIII.

CONCLUDING REMARKS.

The original plan of the present work contemplated a comparison of the observed fluctuations with those of the earth's rotation, assuming the latter to be corrected by observations of Jupiter's satellites and by transits of Mercury. The author made a fairly complete list of the less known observations on eclipses of Jupiter's first satellite from the time of the early Paris astronomers, Picard, etc., until nearly the present. The idea of the comparison is this:

Making abstraction of possible limitations imposed by the laws of motion, the observed fluctuations in the moon's mean motion may be equally due to actual changes in that motion or to changes in the earth's rotation leading to errors in our measurement of time. Which alternative is to be chosen can be determined only by having some independent method of detecting errors in our measure of time. Only two tests on this point are available, one consists in the observed transits of Mercury, the other in observations of Jupiter's satellites.

In the Researches of 1878 will be found a tabular exhibit of the corrections to the measure of time which would account for the observed fluctuations up to 1877. But this is imperfect as regards the period 1750–1870, because the investigation was not complete for that interval. It was there assumed that Hansen's tables represented observations of the moon during the century in question. The results of the present work show that this is far from being the case. The author's discussion of all observed transits of Mercury up to 1881 is found in the first volume of Astronomical Papers prepared for the use of the American Ephemeris. A special effort was made to decide the question whether the observed fluctuations in the moon's motion could be attributed to changes in the earth's rotation, but the question was left in doubt, the inequalities derived from transits of Mercury being only one authority of those necessary to explain the phenomena. It followed that while it was still possible that the inequalities were partly due to the cause in question they were mainly unreal.

About May, 1896, the subject was again taken up in a paper published in the Comptes Rendus (Tome 122, p. 1235). The observations of the transit of 1891 had been made and published in the meantime, and of course would add greatly to the result. The comparison of the observed and theoretical times of the phases was made with the author's new tables of Mercury and the sun, which had just been brought to completion in manuscript. Only November transits were used, the weight of the May transits being very small. Since then the transit of November 13, 1907, has been observed.

The general outcome of these comparisons at the present time is that the curious anomaly of fluctuations, one-third of the magnitude of those required to explain the seeming lunar inequalities, have disappeared. In fact, the fluctuations in the earth's axial rotation, as indicated by transits of Mercury, are no greater than the possible errors of the results. The conclusion to be drawn from all the observed transits of Mercury up to date is that the earth's axial rotation is nearly invariable and can be affected by no inequalities exceeding a small fraction of those needed to explain the apparent fluctuations in the moon's mean motion.

It will still be of interest to test the question by the observations of Jupiter's satellites. The author hopes that this will speedily be done with the aid of the material which he has gathered for the purpose, and which is in good shape for use.

An elaborate discussion of the corrections for reducing eclipses of Jupiter's satellites has been made by Professor Glasenapp. If the proposed new discussion is to be exhaustive, these corrections should be taken account of. But for the practical purpose of the work little will be gained by doing so because the unavoidable probable errors of the observations are of a nature that can be eliminated only by multiplying the number of observations and not by minute corrections to them. A necessary supplement to the present work as published is my own work on solar eclipses. Only two determinations are to be sought for from this source. One is the longitude of the moon's node, which ought to be determinable with great precision from the observed path of the moon's shadow. The other is the sun's longitude relative to the stars using the moon as an intermediary.

The lack of modern determinations of the shadow path in total solar eclipses is very curious, especially as the author has made various attempts to either carry out such determinations himself or to have them done by others. The first author who seems to have been alive to the interest and importance of this determination was Halley, who, before the eclipse of 1715, May 3, organized a special set of observations to determine the limits of totality on either side. His observations are found in the Philosophical Transactions, and are very fully described by the writer in his Researches of 1878.

In view of the interest and importance of the subject it is a curious illustration of the unsystematic way in which astronomical work is organized that nearly 100 years elapsed before anyone else attempted to repeat Halley's enterprise. Nathaniel Bowditch, the celebrated translator of the Mecanique Celeste, essayed a similar set of determinations for the total eclipse of 1806. The data which he derived are fully published in the Memoirs of the American Academy of Arts and Sciences. The author has undertaken, as a part of the present work, to determine the shadow path from these data. But he found himself unable to derive any consistent results for either limit of the shadow. How the discrepancies between the reports of the observers are to be explained it is hard to see. The observations look as good on every phase as those made by Halley's observers a century ago. It is barely possible that the author has himself overlooked some point in connection with the stations or made some error in his discussion. But he must leave it to others to ascertain whether such is the case.

The writer himself assayed a similar set of determinations during the total eclipse of 1869. These were entirely successful, and he believes that the limits of the shadow path can be determined from the reports in the official observations of the eclipse with very great precision. But he has not had time to derive the conclusions.

A similar effort was made during the total eclipse of 1878, observations of which will be found in the author's reports of this eclipse. But the uncertainty of the geographical position of many of the stations necessitated a continual postponement of the final discussion until it became too late to undertake it.

When the American photoheliograph for photographing the transits of Venus was designed a greatly improved system of determining the center of the shadow path became available. By photographs of the partial phase on each side of totality as made with this instrument it would have been easy to locate the path of the center of the axis of the shadow. But it is singular that every effort which he made to apply the instrument was frustrated in one way or another. In 1878 his own photographs were a total failure, through the carelessness of the official authority who prepared the instructions for taking them. The result was that they were too faint to admit of measurement. It is needless to catalogue the several eclipses which have since occurred and to state in detail how each attempt to use the photoheliograph for the purpose in question was a failure. This is all the more to be regretted because in reality a total eclipse is not necessary for the determination. The fact is that photographs of the annulus taken on each side of the center are not only as good as but much better than those pertaining to the total phase.

The author earnestly hopes that the science of geometric astronomy will not continue in the backward state implied by these failures.

The enigmatical character of the inequalities brought out in the present work has been shown in the author's address to the International Association of Mathematicians at Rome in 1908. It seems almost impossible to construct any explanation of the phenomenon without in some way setting aside the fundamental laws of dynamics. Tidal retardation will not account for the fluctuations unless modified in some way not now apparent. In fact, this retardation will affect the actual motion of the moon as well as the length of the day, and what forms the basis of the paradox itself, the difference of the earth's rotation and the moon's fluctuation, and not a sum which would result from retardation.

The author had intended to reinvestigate the whole question of tidal retardation taking into account the tidal action of the three bodies, the sun, moon, and earth. A necessary part of this work would be an expression of the dynamical action of the sun and moon on the tidal wave in true terms of the modification in the form of the wave produced by friction. This is a chapter on the subject which the author believes has remained uninvestigated even by Darwin. These hints are dropped merely with the hope that they may be found useful to the future investigator who shall inquire into the theory.

The most unsatisfactory feature of the conclusion of the entire work as carried through by the author is that, until the matter is cleared up, it will be impossible to predict the moon's longitude with the precision required for astronomical purposes. We shall be obliged to correct the moon's mean longitude from time to time, perhaps at intervals of 10 or 20 years, from observations.

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Perez Fisher	*Assistant Astronomer*
Isabel M. Lewis	*Assistant Astronomer*
George F. Crawley	*Assistant Astronomer*
Clifford S. Lewis	*Assistant Astronomer*
Joseph J. Arnaud	*Assistant Astronomer*
Morris Liferock	*Junior Astronomer*
Catherine de M. Lewis	*Junior Astronomer*
Charles L. Rush	*Junior Astronomer*
Rudolph J. Joers	*Junior Astronomer*

Note.—Those whose names are printed in italics devote only a small portion of their time to work of the Nautical Almanac Office.

January, 1926.

THE ORBIT OF NEPTUNE'S SATELLITE

AND THE

POLE OF NEPTUNE'S EQUATOR

BY

W. S. EICHELBERGER and ARTHUR NEWTON

PREFACE.

The determination of a new orbit of the satellite of Neptune had been begun by Prof. Simon Newcomb at the time of his death. Later the uncompleted work was kindly turned over to the Nautical Almanac Office by his family for completion. A full statement of the state of the work at that time is contained in the pages following this preface.

The Naval Observatory wishes also to acknowledge the kindness of Prof. E. B. Frost, Director of the Yerkes Observatory, in furnishing in manuscript the last three series of observations of the satellite made by Professor Barnard.

EDWIN T. POLLOCK,
Captain, U. S Navy,
Superintendent, Naval Observatory.

WASHINGTON, *January, 1926.*

CONTENTS.

THE ORBIT OF NEPTUNE'S SATELLITE AND THE POLE OF NEPTUNE'S EQUATOR

INTRODUCTORY REMARKS.

Several years after the death of Prof. Simon Newcomb in 1909, the Nautical Almanac Office, in response to a suggestion from its Director, received from the family of Professor Newcomb his uncompleted work on the orbit of the satellite of Neptune.

The following statement concerning the work was left by Professor Newcomb:

"The most complete discussion of the orbit of Neptune's satellite that has been published up to the present time is that of Hermann Struve found in his memoir, *Beobachtungen des Neptunstrabanten am 30-zölligen Pulkowaer Refractor, Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg, VII^eSérie, Tome XLII, No. 4.* In this memoir are discussed all the observations made from the time of the discovery of the satellite by Lassell in 1846 up to 1892.

"During the period which has since elapsed a mass of observations has accumulated much greater than that made use of by Struve. Of these, several special series have been worked up by Professors See, Brown, and others, but none of these includes a complete discussion of all the material.

"Added interest is given to the subject by the application of the photographic method which has been made at several observatories, notably those of Mount Hamilton and Greenwich. These discussions may be supposed almost entirely free from the systematic personal errors to which eye observations, especially of distance, are liable. The magnitude of these errors is shown in the diversity among the values of the mass of Neptune derived from the work of different observers. In this connection attention may be called to defects in the method of making the measures of distances. When, as is sometimes the case, these measures are made by setting one thread centrally across the planet and moving the other to such a distance that the satellite shall appear midway between the threads, the presence of the planet may be expected to influence the judgment as to the position when the satellite is midway between the threads. No reliance can therefore be placed on values of the mass of Neptune derived by this method. The better and more accurate method is to set one thread on the planet and the other on the satellite. But it can not be claimed that even this method does away with the necessity of special effort on the part of the observer to avoid the error which may arise from dividing the attention between the bisection of the planet and that of the satellite. In his own measures, made in 1874, the author made it a rule not to record a measure of distance as satisfactory until, by repeated careful examination of both bisections, the simultaneous accuracy of both seemed to be assured.

"The subject is worthy of special attention because the psychology of observation has not been sufficiently developed on the astronomical side, and the command of the results reached by psychologists is now necessary to the perfection of methods of astronomical observation.

"In the present work no attempt has been made to rediscuss those observations from which the resulting elements have already been sufficiently derived. This seems to be the case with all the observations made use of by Professor Struve. It has, however, been deemed best to rediscuss all the observations (1892–1908) made since the publication of his memoir, using the few published discussions which exist as checks against accidental errors in computation.

"The order of subjects is as follows:

1. Provisional theory, based on Struve's elements, to be corrected by observation. In constructing this theory Marth's system of constants is adopted.
2. Examination and classification of observations used and their comparison with the distance and position-angle derived from the provisional theory.
3. Formation of the equations of condition and of the normal equations, and their solution for the different series of observations employed.
4. Discussion of results, and of the resulting mass of Neptune.

"PROVISIONAL THEORY.

"The adopted provisional elements of the satellite are derived from the work of Struve.* We follow the usual notation:

N = the right ascension of the ascending node of the orbit on the plane of the Earth's equator;
I = the inclination of the orbit to the same plane;
$u_{\oplus}$ = the mean angular distance of the satellite in its orbit from the ascending node of the orbit on the plane of the Earth's equator;
a = the semi-major axis of the orbit.

"The adopted numerical values are [1889–1908]:

$u_{\oplus} = 234\overset{\circ}{.}42$ for 1890, Jan. 0, G. M. N.
$n = 61\overset{\circ}{.}25748$
$N = 185\overset{\circ}{.}15 + 0\overset{\circ}{.}148\ (T-1890.0)$
$I = 119\overset{\circ}{.}35 - 0\overset{\circ}{.}165\ (T-1890.0)$
$a = 16\overset{''}{.}30$, for mean distance [1.47814]
$e = 0$

Here n is the daily motion of $u_{\oplus}$, not the sidereal motion of the satellite."

COMPARISON OF OBSERVATION WITH PROVISIONAL THEORY.

The formulae used for computing the values of p and s, the position angle and distance, are, using the notation of Struve:

$$s \sin (p-P) = r \sin (u_{\oplus} - U)$$
$$s \cos (p-P) = r \sin B \cos (u_{\oplus} - U)$$
$$\cos B \sin U = \cos \delta \sin (\alpha - N) \cos I + \sin \delta \sin I$$
$$\cos B \cos U = \cos \delta \cos (\alpha - N)$$
$$\sin B = \cos \delta \sin (\alpha - N) \sin I - \sin \delta \cos I$$
$$\cos B \sin P = -\cos (\alpha - N) \sin I$$
$$\cos B \cos P = \sin \delta \sin (\alpha - N) \sin I + \cos \delta \cos I$$

where

$$r = \frac{a\,[1.47814]}{\rho} = \frac{16\overset{''}{.}30\,[1.47814]}{\rho} = \frac{[2.69033]}{\rho},$$

and ρ, α, δ are the geocentric coordinates of Neptune.

Under the direction of Professor Newcomb the position angle and distance had been computed from the provisional elements for the time of each of the observations of Neptune's satellite given in Table I from 1889 to 1908, and much work had been done on the computation of the differential coefficients of the equations of condition for determining the corrections to the provisional elements. As there was uncertainty about just what portions of this work had been checked, a duplicate computation covering the entire period was made in the Nautical Almanac Office and the list of observations to be discussed was extended from 1908 to 1923.

Before commencing the computations for these additional observations, the following corrections were applied to the provisional elements—

	1908.0	1912.0	1916.0	1920.0	1924.0
	°	°	°	°	°
du	+0.701	+0.819	+0.941	+1.067	+1.197
dN	+0.948	+1.190	+1.453	+1.736	+2.039
dI	+0.312	+0.506	+0.737	+1.006	+1.313

thus materially reducing the size of the right-hand members in the normal equations of these years.

Table I contains all the observations discussed, the corresponding quantities obtained from the provisional theory, the corrections to the results from the provisional theory, dp, ds, and $s \sin dp$, and the residuals, v, remaining from using in each group of observations the corrected elements derived by a least square solution from that group. From this table are omitted all the observations made at Greenwich as it was decided to make use of the discussion of those observations as published in the annual volumes of that observatory.

The second column, *Greenwich M. T.—Aber. Time*, is the time of the computed position angle, i. e., the time of observing the position angle minus the aberration time. This time corrected by Δt, column 6, the time of observing the distance minus that of observing the position angle, gives the time of the computed distance.

* The values of a and e were adopted by Newcomb and are not the result of Struve's discussion.

TABLE I.—*Comparison of Observations with Theory.*

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1889 h m	°	°	°	m	″	″	″	″	″	″	
Leander McCormick: Parrish.	Oct. 28 15 29	134.3	134.30	0.00	----	----	9.09	----	----	.00	+.12	A. J. XII, 90.
	28 16 23	129.5	130.13	−0.63	----	----	9.20	----	----	−.10	+.02	
	Nov. 24 14 31	266.9	270.29	−3.39	+18	13.24	12.57	+.67	+.73	−.74	−.84	
	Dec. 12 10 4	264.1	260.34	+3.76	+25	13.65	14.04	−.39	−.30	+.91	+.86	
	13 10 13	222.9	224.58	−1.68	+30	15.79	16.18	−.39	−.15	−.48	−.22	
	19 10 55	218.0	219.02	−1.02	----	----	15.47	----	----	−.28	+.03	
	21 10 41	71.3	71.24	+0.06	+22	15.42	15.45	−.03	−.03	+.02	−.19	
	23 11 5	320.3	317.30	+3.00	+ 2	8.66	8.85	−.19	−.26	+.46	+.34	
	1891–92											
U. S. Naval Obs.: A. Hall, jr.	Nov. 7 12 41	193.00	191.00	+2.00	0	11.80	11.23	+.57	+.37	+.39	+.55	A. J. XII, 22.
	9 12 17	59.20	56.65	+2.55	0	16.55	16.90	−.35	−.65	+.75	+.72	
	11 11 38	276.91	276.63	+0.28	0	11.95	12.58	−.63	−.81	+.06	+.26	
	29 11 43	255.55	257.76	−2.21	0	15.42	15.30	+.12	−.14	−.59	−.34	
	30 10 36	221.55	223.48	−1.93	0	16.46	15.72	+.74	+.50	−.53	−.30	
	Dec. 1 10 59	145.60	150.54	−4.94	----	----	9.35	----	----	−.81	−.74	
	5 10 41	254.76	254.44	+0.32	0	16.26	15.75	+.51	+.24	+.09	+.34	
	8 10 50	73.70	71.82	+1.88	0	16.44	16.08	+.36	+.10	+.53	+.52	
	9 10 52	35.05	35.16	−0.11	0	14.73	14.48	+.25	−.01	−.03	−.08	
	10 10 58	309.86	310.74	−0.88	----	----	9.66	----	----	−.15	−.05	
	17 9 35	246.51	246.92	−0.41	0	16.82	16.56	+.26	−.03	−.12	+.14	
	18 10 19	204.80	207.05	−2.25	0	13.82	13.23	+.59	+.38	−.52	−.33	
	28 9 12	284.60	284.43	+0.17	0	11.59	11.36	+.23	+.09	+.03	+.21	
	30 9 25	190.90	194.02	−3.12	0	11.64	11.53	+.11	−.09	−.63	−.47	
	31 9 23	101.10	99.54	+1.56	0	11.57	11.89	−.32	−.52	+.32	+.32	
	Jan. 7 9 53	51.65	51.69	−0.04	0	16.96	16.61	+.35	+.05	−.01	−.04	
	16 8 31	224.90	227.13	−2.23	0	16.11	16.11	.00	−.26	−.63	−.39	
	17 8 26	165.40	165.08	+0.32	0	9.06	9.42	−.36	−.55	+.05	+.15	
	20 9 17	335.25	334.53	+0.72	0	9.25	9.15	+.10	+.04	+.12	+.15	
	21 7 42	258.90	259.77	−0.87	0	15.27	14.53	+.74	+.49	−.22	+.02	
	27 8 8	253.00	253.87	−0.87	0	15.92	15.37	+.55	+.28	−.23	+.02	
	Feb. 5 8 15	65.55	66.88	−1.33	0	16.54	16.15	+.39	+.13	−.38	−.39	
	11 7 45	61.95	63.29	−1.34	0	16.81	16.39	+.42	+.15	−.38	−.39	
	12 7 59	21.35	23.18	−1.83	----	----	12.44	----	----	−.40	−.45	
	13 8 26	285.50	288.11	−2.61	0	10.82	10.64	+.18	+.06	−.49	−.32	
	15 8 22	200.15	198.35	+1.80	0	11.86	11.79	+.07	−.13	+.37	+.54	
	17 8 10	58.50	58.57	−0.07	0	17.44	16.50	+.94	+.66	−.02	−.04	
	Mar. 3 9 4	226.90	226.81	+0.09	0	15.30	15.68	−.38	−.63	+.02	+.25	
	1892–93											
Lick: Barnard.	Oct. 2 18 27	87.87	90.51	−2.64	− 4	14.05	13.80	+.25	+.18	−.64	−.38	A. J. XIII, 10.
	Nov. 13 14 50	61.53	61.90	−0.37	+ 9	17.13	16.96	+.17	.00	−.11	.00	
	18 18 15	91.87	91.47	+0.40	+ 8	13.72	13.76	−.04	−.10	+.10	+.37	
	20 17 23	357.50	357.32	+0.18	+ 9	9.84	10.24	−.40	−.29	+.03	−.06	
	Dec. 9 14 30	258.78	258.49	+0.29	+ 9	15.50	15.55	−.05	−.11	+.08	+.31	
	16 12 6	220.55	220.67	−0.12	+ 8	15.14	15.09	+.05	+.01	−.03	+.01	
	Jan. 8 14 55	234.08	235.39	−1.31	+ 5	16.99	16.71	+.28	+.18	−.38	−.26	
	13 15 2	268.45	269.19	−0.74	+ 9	13.59	13.67	−.08	−.07	−.18	+.06	
	20 12 7	230.30	230.75	−0.45	+ 9	16.44	16.29	+.15	+.07	−.13	−.04	
	1893–94											
Lick: Barnard.	Nov. 12 18 16	70.52	70.51	+0.01	+ 8	16.77	16.73	+.04	+.07	.00	−.03	A. J. XIV, 9.
	13 18 15	30.28	29.50	+0.78	+ 9	12.86	13.20	−.34	−.23	+.18	+.18	
	Dec. 3 13 51	239.92	241.52	−1.60	+ 8	16.63	16.96	−.33	−.33	−.47	−.25	
	10 14 28	180.60	180.78	−0.18	+ 9	10.68	10.51	+.17	+.19	−.03	+.10	
	Jan. 7 14 32	249.50	249.37	+0.13	+10	16.89	16.63	+.26	+.23	+.04	+.27	
	10 12 55	70.10	69.55	+0.55	+ 6	16.54	16.59	−.05	−.01	+.16	+.13	
	21 14 18	101.68	101.69	−0.01	+ 7	12.40	12.36	+.04	+.04	.00	.00	
	22 12 26	61.15	61.47	−0.32	+ 7	16.85	16.76	+.09	+.14	−.09	−.12	
	28 11 15	58.80	58.87	−0.07	+ 8	16.56	16.66	−.10	−.05	−.02	−.05	
	Feb. 26 11 37	71.40	71.87	−0.47	+ 8	15.92	15.97	−.05	−.02	−.13	−.16	
	1894–95											
Lick: Barnard.	Nov. 18 19 15	40.05	39.71	+0.34	+ 7	14.22	14.45	−.23	−.25	+.09	+.06	A. J. XV 42.
	19 18 36	319.02	319.99	−0.97	+ 8	10.16	10.23	−.07	+.04	−.17	−.14	
	Dec. 23 13 25	60.10	60.23	−0.13	+12	16.84	16.83	+.01	+.01	−.04	−.01	
	31 14 44	269.50	269.83	−0.33	+ 8	14.54	14.58	−.04	.00	−.08	+.06	
	Jan. 6 12 58	267.05	267.45	−0.40	+ 6	14.88	14.86	+.02	+.05	−.10	+.04	
	28 13 16	27.78	27.55	+0.23	+ 7	12.54	12.81	−.27	−.27	+.05	.00	
	Feb. 4 10 49	297.15	295.94	+1.21	+12	11.07	11.23	−.16	−.06	+.24	+.33	
	5 11 13	244.82	245.88	−1.06	+ 8	16.56	16.66	−.10	−.14	−.31	−.19	
	17 12 25	234.30	235.24	−0.94	+ 9	16.26	16.19	+.07	+.01	−.27	−.20	
	18 12 36	177.80	176.52	+1.28	+47	9.94	9.96	−.02	−.01	+.23	+.12	
	24 11 40	170.14	168.18	+1.96	+14	9.79	9.72	+.07	+.10	+.33	+.22	
	25 11 1	87.82	88.84	−1.02	+ 9	14.19	14.22	−.03	+.07	−.25	−.22	
	Mar. 3 11 20	82.82	82.69	+0.13	+17	15.26	15.03	+.23	+.31	+.03	+.07	
	4 11 25	44.90	44.69	+0.21	+ 7	15.01	14.87	+.14	+.12	+.05	+.04	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	s sin dp O−C	s sin dp v	Remarks.
	1894–95 h m	°	°	°	m	"	"	"	"	"	"	
Lick: Schaeberle.	Dec. 13 12 26	298.73	298.97	−0.24	− 2	10.98	11.30	−.33	−.22	−.05	+.02	A. J. XV, 26.
	Jan. 10 11 47	49.10	48.64	+0.46	0	15.85	15.77	+.08	+.04	+.13	+.03	
	25 14 24	207.22	208.41	−1.19	− 3	12.93	12.97	−.04	+.08	−.27	−.09	
	26 13 38	121.73	121.44	+0.29	+ 2	10.84	10.81	+.03	−.02	+.05	+.19	
	29 14 9	294.36	294.71	−0.35	+ 1	11.48	11.33	+.15	+.26	−.07	+.01	
	30 11 45	248.88	249.56	−0.68	+ 2	16.45	16.57	−.12	−.06	−.20	−.04	
	31 12 40	204.91	205.31	−0.40	+ 3	12.17	12.55	−.38	−.27	−.09	+.09	
	Feb. 2 12 6	66.64	66.81	−0.17	+ 1	16.84	16.66	+.18	+.13	−.05	−.09	
	3 11 59	23.54	23.19	+0.35	− 2	12.24	12.29	−.05	−.04	+.07	−.06	
	6 11 45	198.91	199.70	−0.79	− 1	11.75	11.88	−.13	−.02	−.16	+.02	
	1895–96											
Lick: Schaeberle.	Oct. 22 16 46	219.18	220.54	−1.36	+ 2	14.18	14.18	.00	+.04	−.34	−.15	A. J. XVII, 62.
	26 16 19	313.22	313.70	−0.48	+ 5	10.58	10.74	−.16	−.10	−.09	−.05	
	27 15 43	257.82	257.67	+0.15	+ 2	16.52	16.48	+.04	+.10	+.04	+.22	
	28 15 36	215.93	216.64	−0.71	+ 1	13.68	13.73	−.05	−.02	−.17	+.02	
	29 15 45	129.29	130.25	−0.96	+ 4	10.99	10.92	+.07	+.05	−.18	−.09	
	Nov. 9 15 32	200.72	201.14	−0.42	+ 5	12.04	12.05	−.01	+.01	−.09	+.08	
	16 14 50	105.4	105.98	−0.58	----	------	13.10	------	------	−.13	−.04	
	20 14 15	240.62	241.42	−0.80	+ 1	16.81	16.74	+.07	+.13	−.23	−.03	
	Dec. 1 13 19	272.68	272.63	+0.05	----	------	14.78	------	------	+.01	+.15	
	7 13 31	265.62	266.60	−0.98	+ 1	15.54	15.55	−.01	+.06	−.27	−.11	
	9 13 17	153.71	154.34	−0.63	− 4	10.23	10.12	+.11	+.09	−.11	.00	
	31 12 16	248.27	248.85	−0.58	− 1	16.76	16.91	−.15	−.09	−.17	+.02	
	Jan. 1 12 43	201.15	202.64	−1.49	----	------	12.29	------	------	−.32	−.15	
	2 12 58	112.15	112.11	+0.04	+ 1	11.96	12.17	−.21	−.21	+.01	+.10	
	Feb. 21 11 47	291.44	292.16	−0.72	+ 2	11.61	11.77	−.16	−.09	−.15	−.07	
	1896											
Lick: Schaeberle.	Oct. 16 16 46	100.49	100.68	−0.19	+ 9	13.90	14.14	−.24	−.17	−.05	+.04	A. J. XVII, 62.
	17 16 58	59.23	59.42	−0.19	− 3	16.30	16.17	+.13	+.07	−.05	−.03	
	27 15 58	162.33	163.06	−0.73	− 1	10.07	10.24	−.17	−.10	−.13	−.17	
	28 15 24	91.69	91.45	+0.24	+ 1	15.30	15.32	−.02	+.02	+.06	+.16	
	29 14 43	52.53	53.05	−0.52	+42	15.49	15.47	+.02	−.03	−.14	−.15	
	30 16 40	334.10	333.98	+0.12	+19	10.09	10.30	−.21	−.05	+.02	+.08	
	Nov. 6 17 21	259.48	260.34	−0.86	+ 3	16.72	16.50	+.22	+.17	−.25	.00	
	1896–97											
Lowell: Drew.	Oct. 16 16 5	99.7	102.21	−2.51	+28	13.75	14.04	−.29	−.25	−.61	−.61	A.J.XVII,132.
	19 15 59	280.0	279.19	+0.81	+10	14.17	14.35	−.18	−.03	+.20	+.24	
	29 16 15	52.0	50.24	+1.76	−11	15.18	15.32	−.14	−.14	+.47	+.34	
	30 15 44	338.4	337.92	+0.48	+17	10.25	10.27	−.02	+.11	+.09	−.03	
	Nov. 4 16 15	44.1	44.37	−0.27	+23	14.22	14.47	−.25	−.25	−.07	−.21	
	6 15 49	263.0	262.85	+0.15	+28	15.71	16.36	−.65	−.51	+.04	+.11	
	7 15 52	222.4	222.07	+0.33	+28	14.21	14.16	+.05	+.16	+.08	+.17	
	Jan. 6 11 41	132.3	135.19	−2.89	----	------	10.75	------	------	−.54	−.50	
	7 11 49	77.7	77.23	+0.47	----	------	16.60	------	------	+.14	+.09	
	8 11 26	38.4	36.33	+2.07	----	------	13.74	------	------	+.50	+.35	
	9 14 45	298.3	299.41	−1.11	+24	11.39	11.92	−.53	−.37	−.23	−.25	
	11 13 52	209.7	206.43	+3.27	+19	11.69	12.49	−.80	−.70	+.72	+.80	
	14 13 58	20.2	21.93	−1.73	+39	11.73	11.93	−.20	−.17	−.37	−.53	
	18 14 9	108.5	108.35	+0.15	+32	12.45	13.00	−.55	−.51	+.03	+.04	
	28 14 26	234.7	236.77	−2.07	+43	16.04	16.07	−.03	+.09	−.58	−.50	
	30 14 8	94.9	94.60	+0.30	+24	14.85	14.55	+.30	+.35	+.08	+.06	
	Feb. 1 14 55	346.3	346.30	0.00	----	------	10.11	------	------	.00	−.14	
	6 12 34	53.5	52.41	+1.09	+20	15.73	15.61	+.12	+.13	+.30	+.19	
	8 13 56	264.5	266.43	−1.93	+31	15.16	15.51	−.35	−.21	−.52	−.46	
	13 13 40	326.2	326.74	−0.54	+41	10.25	10.18	+.07	+.21	−.10	−.20	
	18 13 12	40.7	39.88	+0.82	+23	14.32	13.89	+.43	+.44	+.20	+.06	
	19 13 10	316.6	316.91	−0.31	+39	9.91	10.51	−.60	−.45	−.06	−.13	
	20 13 19	256.9	257.50	−0.60	+21	15.54	16.24	−.70	−.57	−.17	−.09	
	21 12 23	216.3	218.43	−2.13	+29	13.52	13.66	−.14	−.03	−.51	−.43	
	22 12 48	133.5	132.63	+0.87	+31	10.87	10.68	+.19	+.19	+.16	+.20	
	23 12 7	75.7	77.03	−1.33	+36	16.34	16.27	+.07	+.11	−.38	−.43	
	24 12 2	34.8	35.86	−1.06	+29	13.32	13.29	+.03	+.04	−.25	−.39	
	25 10 54	312.1	314.22	−2.12	+28	10.27	10.57	−.30	−.14	−.39	−.45	
	27 12 38	210.4	210.82	−0.42	+17	12.87	12.73	+.14	+.24	−.09	−.01	
	28 11 26	128.1	126.84	+1.26	+22	10.84	10.97	−.13	−.09	+.24	+.27	
	Mar. 1 11 22	73.7	73.56	+0.14	+31	16.70	16.39	+.31	+.35	+.04	−.02	
	2 11 24	29.2	30.22	−1.02	+24	13.05	12.60	+.45	+.47	−.23	−.38	
	3 10 10	302.0	306.10	−4.10	+26	11.47	11.00	+.47	+.63	−.78	−.82	
	4 10 2	253.2	253.33	−0.13	+20	15.97	16.36	−.39	−.27	−.04	+.04	
	6 10 0	122.7	121.66	+1.04	+28	11.27	11.33	−.06	−.02	+.20	+.22	
	7 10 8	73.0	70.90	+2.10	+26	15.90	16.41	−.51	−.47	+.60	+.54	
	8 10 2	24.5	25.95	−1.45	+26	12.44	12.08	+.36	+.38	−.31	−.46	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.			Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	s sin dp O−C	s sin dp v	Remarks.
	1897	h	m	°	°	°	m	"	"	"	"	"	"	
Lowell:	Mar. 9	10	10	299.1	296.40	+2.70	+26	11.31	11.75	−.44	−.28	+.55	+.54	
Drew.	10	9	48	250.5	249.15	+1.35	+28	16.32	16.40	−.08	+.04	+.39	+.47	
	11	9	53	202.9	202.18	+0.72	+20	11.84	11.72	+.12	+.21	+.15	+.23	
	12	9	57	113.7	112.73	+0.97	+23	12.51	12.09	+.42	+.46	+.20	+.21	
	19	9	27	65.4	62.93	+2.47	+19	16.67	16.16	+.51	+.53	+.70	+.62	
	25	9	39	60.1	57.94	+2.16	+11	16.72	15.76	+.96	+.98	+.59	+.49	
	26	9	52	354.9	356.31	−1.41	+16	10.00	10.02	−.02	+.06	−.25	−.39	
	27	10	24	275.5	273.86	+1.64	+24	13.42	14.21	−.79	−.65	+.40	+.45	
	1897													
Lick:	Sept. 13	18	54	277.57	278.88	−1.31	− 1	14.77	14.44	+.33	+.23	−.33	−.07	A.J.XVIII,168.
Schaeberle.	18	19	19	342.34	343.45	−1.11	+14	10.10	10.16	−.06	−.05	−.20	−.05	
	Oct. 16	16	34	74.21	74.73	−0.52	0	16.69	16.70	−.01	−.06	−.15	−.07	
	18	16	29	298.89	299.95	−1.06	+ 1	12.40	12.31	+.09	+.03	−.23	.00	
	29	16	45	6.61	7.08	−0.47	− 1	10.95	10.93	+.02	+.03	−.09	+.03	
	30	15	30	286.41	287.02	−0.61	+ 1	13.86	13.74	+.12	+.03	−.15	+.10	
	Nov. 1	15	56	184.13	184.66	−0.53	− 1	10.93	10.84	+.09	−.01	−.10	−.06	
	12	15	37	233.33	234.09	−0.76	0	15.74	15.59	+.15	+.02	−.21	−.02	
	15	15	5	52.30	52.32	−0.02	0	15.55	15.41	+.14	+.09	−.01	+.07	
	27	15	26	39.13	39.11	+0.02	+14	13.59	13.77	−.18	−.21	.00	+.09	
	29	14	22	259.78	260.78	−1.00	+13	16.72	16.70	+.02	−.11	−.29	−.03	
	Dec. 3	15	37	30.68	31.24	−0.56	0	13.04	12.96	+.08	+.07	−.13	−.04	
	11	12	41	252.85	253.92	−1.07	− 1	17.16	16.96	+.20	+.07	−.32	−.07	
	24	12	18	189.68	189.46	+0.22	− 1	10.98	11.18	−.20	−.31	+.04	+.08	
	25	14	41	99.72	99.45	+0.27	− 1	14.49	14.55	−.06	−.08	+.07	+.11	
	27	12	14	3.75	4.35	−0.60	− 2	11.17	10.91	+.26	+.28	−.11	+.01	
	1897–98													
Yerkes:	Sept. 14	16	38	242.48	242.23	+0.25	+13	16.02	15.88	+.14	+.21	+.07	+.28	A. J. XIX, 27.
Barnard.	20	17	36	235.00	235.36	−0.36	+ 7	15.32	15.26	+.06	+.12	−.10	+.08	
	22	17	8	93.19	93.67	−0.48	+ 7	14.83	15.17	−.34	−.24	−.13	−.04	
	24	18	27	335.10	334.84	+0.26	+ 6	9.90	10.29	−.39	−.20	+.05	.00	
	26	16	54	230.44	231.09	−0.65	+ 6	14.84	14.80	+.04	+.10	−.17	.00	
	Oct. 3	16	35	144.70	144.64	+0.06	+ 9	10.68	10.64	+.04	+.14	+.01	+.06	
	6	17	47	315.59	314.76	+0.83	+ 8	10.81	11.15	−.34	−.12	+.16	+.19	
	8	15	59	219.83	220.41	−0.58	+ 7	14.02	13.60	+.42	+.47	−.14	−.01	
	12	15	30	311.47	312.46	−0.99	+ 9	11.05	11.32	−.27	−.05	−.20	−.15	
	14	15	30	213.58	214.26	−0.68	+ 7	12.50	12.95	−.45	−.40	−.15	−.03	
	25	15	6	248.85	250.00	−1.15	+ 7	16.85	16.72	+.13	+.22	−.34	−.11	
	26	14	1	201.90	201.57	+0.33	+ 6	11.71	11.82	−.11	−.06	+.07	+.15	
	Nov. 2	15	41	101.75	103.21	−1.46	+ 8	14.18	14.25	−.07	+.04	−.36	−.26	
	9	17	38	53.16	53.09	+0.07	+ 8	15.25	15.43	−.18	−.20	+.02	−.01	
	22	13	8	335.18	334.50	+0.68	+ 9	9.92	10.51	−.59	−.39	+.12	+.07	
	23	13	27	268.56	267.32	+1.24	+10	15.68	16.16	−.48	−.34	+.35	+.59	
	Dec. 6	17	10	202.00	202.54	−0.54	+10	12.40	12.07	+.33	+.39	−.11	−.03	
	7	16	27	118.53	116.92	+1.61	+12	12.48	12.67	−.19	−.07	+.35	+.43	
	20	16	45	60.54	60.26	+0.28	+12	16.12	16.39	−.27	−.27	+.08	+.08	
	21	14	27	8.40	6.95	+1.45	+11	10.70	11.01	−.31	−.21	+.28	+.15	
	25	12	4	105.31	105.30	+0.01	+11	13.84	13.87	−.03	+.09	.00	+.09	
	26	11	8	64.00	64.60	−0.60	+ 8	16.74	16.73	+.01	+.02	−.18	−.16	
	27	11	27	7.02	7.27	−0.25	+ 7	10.94	11.03	−.09	+.01	−.05	−.18	
	29	11	2	242.75	242.30	+0.45	+ 8	16.31	16.57	−.26	−.18	+.13	+.34	
	Jan. 1	9	53	61.18	61.75	−0.57	+ 7	16.48	16.52	−.04	−.04	−.16	−.15	
	2	12	14	354.05	352.85	+1.20	+ 5	10.18	10.49	−.31	−.16	+.22	+.11	
	3	15	3	267.25	269.98	−2.73	+ 9	15.68	15.70	−.02	+.13	−.75	−.52	
	16	12	58	222.52	222.24	+0.28	+11	14.41	14.24	+.17	+.23	+.07	+.21	
	17	11	43	143.20	144.82	−1.62	+ 9	10.74	10.58	+.16	+.27	−.30	−.25	
	18	9	45	85.32	86.09	−0.77	+19	15.83	16.03	−.20	−.11	−.21	−.12	
	23	9	49	138.14	140.75	−2.61	+ 9	10.71	10.70	+.01	+.12	−.49	−.44	
	27	13	3	252.26	253.41	−1.15	+ 7	16.59	16.77	−.18	−.08	−.34	−.10	
	Feb. 23	10	28	56.59	56.14	+0.45	+ 6	15.76	15.74	+.02	+.02	+.12	+.11	
	26	9	54	233.37	234.56	−1.19	+ 9	15.53	15.53	.00	+.06	−.32	−.14	
	Mar. 2	10	10	339.39	339.06	+0.33	+ 7	9.90	10.05	−.15	+.03	+.06	−.01	
	5	8	52	158.64	158.31	+0.33	+ 7	9.98	10.04	−.06	+.03	+.06	+.10	
	6	8	46	87.68	88.25	−0.57	+ 5	15.24	15.32	−.08	+.01	−.15	−.06	
	7	8	39	48.73	48.73	0.00	+ 6	14.57	14.78	−.21	−.22	.00	−.05	
	13	8	41	42.30	42.73	−0.43	+16	13.87	13.91	−.04	−.06	−.10	−.17	
	13	9	26	41.96	41.07	+0.89	+ 4	13.92	13.78	+.14	+.12	+.21	+.14	
	14	9	0	320.95	319.73	+1.22	+15	10.14	10.44	−.30	−.08	+.22	+.23	
	15	8	56	261.07	260.42	+0.65	+ 7	15.67	16.00	−.33	−.21	+.18	+.42	
	19	8	57	37.06	35.34	+1.72	+ 8	12.94	13.01	−.07	−.07	+.39	+.29	
	23	9	7	123.06	123.52	−0.46	+10	11.46	11.36	+.10	+.22	−.09	−.03	
	23	9	36	120.53	121.98	−1.45	+ 7	11.70	11.46	+.24	+.36	−.29	−.22	
	29	9	21	113.67	113.95	−0.28	+ 6	12.18	12.17	+.01	+.13	−.06	+.02	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	s sin dp O−C	s sin dp v	Remarks.
	1898 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes: Barnard.	Apr. 1 9 49	287.34	288.76	−1.42	+ 8	12.37	12.71	−.34	−.14	−.31	−.16	
	2 9 39	243.87	245.42	−1.55	+ 9	16.50	16.08	+.42	+.50	−.44	−.23	
	3 9 28	190.50	192.09	−1.59	+ 8	11.15	10.81	+.34	+.40	−.30	−.24	
	5 9 35	63.34	63.19	+0.15	+ 5	16.03	15.94	+.09	+.10	+.04	+.06	
	11 9 43	57.25	58.15	−0.90	+ 5	15.16	15.48	−.32	−.32	−.24	−.24	
	20 9 58	228.35	229.78	−1.43	+ 6	14.50	14.49	+.01	+.07	−.36	−.20	
	23 9 32	47.99	47.78	+0.21	+ 7	13.92	14.21	−.29	−.30	+.05	.00	
	1897–98											
U. S. Naval Obs.: Brown.	Oct. 13 16 0	256.95	257.98	−1.03	+ 2	16.82	16.61	+.21	+.15	−.30	−.19	A.J.XX, 135.
	17 15 22	30.90	30.66	+0.24	+ 2	12.91	12.63	+.28	+.37	+.05	+.33	
	18 15 17	302.07	303.53	−1.46	+ 2	12.04	11.98	+.06	−.04	−.31	−.12	
	29 14 26	15.35	15.37	−0.02	+19	11.72	11.34	+.38	+.43	.00	+.29	
	30 14 26	288.59	289.59	−1.00	0	13.42	13.44	−.02	−.12	−.24	−.08	
	Nov. 3 14 32	62.73	63.71	−0.98	+ 1	15.94	16.47	−.53	−.41	−.28	−.06	
	4 14 7	5.24	5.99	−0.75	0	10.66	10.91	−.25	−.22	−.14	+.14	
	6 13 39	241.70	242.71	−1.01	0	16.76	16.43	+.33	+.26	−.29	−.22	
	13 13 12	171.95	172.31	−0.36	+ 1	10.48	10.50	−.02	−.04	−.07	−.17	
	17 13 10	272.71	273.23	−0.52	0	15.69	15.47	+.22	+.14	−.14	.00	
	20 13 15	90.10	90.32	−0.22	+ 2	15.64	15.81	−.17	−.05	−.06	+.05	
	23 12 54	268.04	268.28	−0.24	+ 2	16.26	16.03	+.23	+.16	−.07	+.06	
	24 12 31	228.44	228.66	−0.22	+ 1	15.34	15.01	+.33	+.25	−.06	−.03	
	27 12 19	44.21	46.03	−1.82	0	14.56	14.70	−.14	−.02	−.47	−.21	
	29 12 12	264.66	264.36	+0.30	0	16.70	16.40	+.30	+.23	+.09	+.21	
	Dec. 7 12 18	128.80	129.86	−1.06	+ 1	11.29	11.52	−.23	−.14	−.21	−.26	
	11 10 32	257.22	257.32	−0.10	+ 9	16.97	16.88	+.09	+.03	−.03	+.08	
	12 10 23	214.15	213.41	+0.74	0	13.29	13.22	+.07	−.02	+.17	+.15	
	15 10 46	24.51	28.44	−3.93	− 2	12.71	12.69	+.02	+.11	−.87	−.59	
	16 10 39	300.28	300.95	−0.67	+20	12.41	12.28	+.13	+.03	−.14	+.05	
	23 10 20	248.05	248.21	−0.16	0	17.13	16.91	+.22	+.16	−.05	+.04	
	26 10 44	65.62	65.20	+0.42	0	16.44	16.78	−.34	−.22	+.12	+.33	
	30 10 49	183.68	184.20	−0.52	+ 5	11.03	10.87	+.16	+.12	−.10	−.18	
	Jan. 1 10 1	60.69	61.53	−0.84	+ 1	16.14	16.52	−.38	−.26	−.24	−.02	
	4 9 5	240.60	240.61	−0.01	− 1	16.71	16.44	+.27	+.20	.00	+.07	
	5 10 6	175.45	175.57	−0.12	+ 2	10.65	10.55	+.10	+.08	−.02	−.11	
	8 9 40	351.85	351.40	+0.45	− 1	10.50	10.44	+.06	+.05	+.08	+.36	
	13 9 15	52.10	52.57	−0.47	0	15.11	15.60	−.49	−.37	−.13	+.11	
	17 10 40	148.42	149.06	−0.64	+17	10.28	10.47	−.19	−.15	−.12	−.20	
	18 8 40	87.95	87.99	−0.04	0	15.39	15.77	−.38	−.26	−.01	+.11	
	21 8 52	264.82	265.03	−0.21	+ 4	16.33	16.07	+.26	+.19	−.06	+.06	
	24 8 36	82.16	82.96	−0.80	0	15.90	16.23	−.33	−.21	−.23	−.09	
	28 8 32	218.66	218.97	−0.31	0	14.05	13.84	+.21	+.12	−.08	−.08	
	Feb. 7 8 14	299.56	300.56	−1.00	− 1	11.78	11.85	−.07	−.17	−.21	−.02	
	9 8 41	204.01	203.14	+0.87	0	12.07	12.04	+.03	−.05	+.18	+.13	
	10 8 6	117.32	116.53	+0.79	0	11.84	12.20	−.36	−.26	+.17	+.17	
	12 8 36	17.82	18.85	−1.03	0	11.60	11.65	−.05	+.02	−.21	+.07	
	13 7 42	292.15	293.48	−1.33	+ 1	12.68	12.48	+.20	+.11	−.29	−.12	
	26 8 34	236.77	236.86	−0.09	0	15.65	15.80	−.15	−.22	−.02	+.04	
	Mar. 5 8 57	156.30	157.96	−1.66	− 1	10.06	10.04	+.02	+.04	−.29	−.38	
	1898–99											
Yerkes: Barnard.	Aug. 29 17 15	87.12	88.04	−0.92	+ 8	15.93	15.76	+.17	+.18	−.25	−.14	A. J. XX, 42.
	30 16 57	46.14	46.98	−0.84	+ 9	13.96	13.85	+.11	+.15	−.20	−.19	
	31 16 58	325.67	325.81	−0.14	+ 9	10.54	10.57	−.03	+.05	−.03	−.07	
	Sept. 1 16 20	267.20	267.11	+0.09	+ 8	15.30	15.85	−.55	−.43	+.02	.00	
	2 16 3	226.72	225.84	+0.88	+ 8	13.59	13.72	−.13	+.03	+.21	+.24	
	2 16 33	224.62	223.98	+0.64	+ 6	13.58	13.60	−.02	+.14	+.15	+.18	
	3 16 38	139.77	141.51	−1.74	+10	10.89	10.79	+.10	+.15	−.33	−.15	
	14 15 43	211.04	211.66	−0.62	+ 8	12.14	12.29	−.15	+.01	−.13	−.07	
	20 16 11	201.64	201.24	+0.40	+12	11.34	11.45	−.11	+.05	+.08	+.17	
	22 18 58	66.60	66.16	+0.44	+ 3	16.09	16.08	+.01	+.05	+.12	+.18	
	26 16 3	191.48	191.55	−0.07	+ 9	10.88	10.92	−.04	+.11	−.01	+.10	
	27 16 2	107.02	108.52	−1.50	+10	13.79	13.80	−.01	.00	−.36	−.20	
	Oct. 10 15 1	56.91	57.48	−0.57	+ 7	15.49	15.42	+.07	+.11	−.15	−.12	
	11 16 11	342.96	341.95	+1.01	+12	10.82	10.44	+.38	+.45	+.18	+.13	
	11 17 4	338.45	338.24	+0.21	+ 8	10.47	10.49	−.02	+.05	+.04	−.01	
	Nov. 7 14 10	121.46	121.85	−0.39	+ 8	12.80	12.56	+.24	+.26	−.09	+.09	
	14 20 4	60.68	59.54	+1.14	+ 5	15.68	15.95	−.27	−.23	+.32	+.36	
	15 12 32	19.99	20.16	−0.17	+ 8	11.76	11.74	+.02	+.06	−.03	−.06	
	22 17 37	276.90	276.44	+0.46	+ 6	15.22	15.45	−.23	−.11	+.12	+.10	
	24 11 29	187.93	188.45	−0.52	+ 6	10.98	11.08	−.10	+.05	−.10	+.02	
	26 11 39	62.72	63.80	−1.08	+ 9	16.41	16.42	−.01	+.03	−.31	−.26	
	29 14 30	236.69	236.15	+0.54	+ 7	15.40	15.67	−.27	−.12	+.15	+.16	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		*dp*	Δ*t*	Distance.		*ds*		*s* sin *dp*		Remarks.
		O	C	O−C		O	C	O−C	*v*	O−C	*r*	
	1898–99 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes:	Dec. 3 12 3	349.51	349.00	+0.51	+ 8	10.44	10.58	−.14	−.08	+.09	+.04	
Barnard.	6 15 38	147.97	148.59	−0.62	+ 9	10.80	10.85	−.05	+.03	−.12	+.06	
	10 11 29	271.66	271.20	+0.46	+ 6	15.50	16.01	−.51	−.38	+.13	+.11	
	11 10 51	231.06	231.77	−0.71	+11	15.12	15.19	−.07	+.09	−.19	−.17	
	12 11 20	152.20	154.03	−1.83	+ 6	10.68	10.68	.00	+.09	−.34	−.16	
	13 11 1	89.02	89.38	−0.36	+ 8	16.70	16.19	+.51	+.52	−.10	+.02	
	Jan. 18 10 16	61.00	61.32	−0.32	+ 8	16.24	16.27	−.03	+.01	−.09	−.05	
	24 9 54	56.57	56.79	−0.22	+ 8	15.86	15.80	+.06	+.10	−.06	−.02	
	30 11 56	47.83	47.22	+0.61	+10	14.19	14.62	−.43	−.39	+.16	+.17	
	31 12 33	325.30	325.61	−0.31	+ 5	10.71	10.70	+.01	+.09	−.06	−.11	
	Feb. 6 9 20	328.08	326.68	+1.40	+ 6	10.22	10.62	−.40	−.32	+.26	+.21	
	7 10 37	262.36	262.61	−0.25	+ 8	16.46	16.38	+.08	+.21	−.07	−.09	
	9 11 46	132.07	132.22	−0.15	+ 7	11.01	11.31	−.30	−.26	−.03	+.15	
	10 9 11	81.79	82.52	−0.73	+ 7	16.34	16.36	−.02	.00	−.21	−.11	
	11 10 30	37.45	37.14	+0.31	+ 9	13.02	13.34	−.32	−.28	+.07	+.06	
	12 10 25	312.16	311.77	+0.39	+ 6	11.06	11.31	−.25	−.15	+.08	+.04	
	13 8 52	260.85	260.60	+0.25	+ 6	16.22	16.45	−.23	−.10	+.07	+.06	
	20 11 11	202.93	203.01	−0.08	+ 2	11.74	11.90	−.16	.00	−.02	+.06	
	28 9 42	66.98	67.50	−0.52	+ 8	16.56	16.41	+.15	+.18	−.15	−.09	
	Mar. 13 10 49	347.09	346.24	+0.85	+13	10.33	10.14	+.19	+.25	+.15	+.10	
	18 9 18	53.16	53.06	+0.10	+ 8	14.78	14.98	−.20	−.16	+.03	+.05	
	19 9 44	338.70	338.46	+0.24	0	9.99	10.13	−.14	−.07	+.04	−.01	
	28 9 49	139.82	140.50	−0.68	+17	10.62	10.59	+.03	+.09	−.13	+.05	
	29 9 31	82.31	82.55	−0.24	0	15.71	15.93	−.22	−.20	−.07	+.03	
	30 10 5	39.02	38.99	+0.03	+ 6	12.74	13.20	−.46	−.42	+.01	+.01	
	Apr. 3 10 9	127.68	128.82	−1.14	+ 4	11.41	11.20	+.21	+.24	−.22	−.04	
	4 9 17	78.20	78.18	+0.02	+ 8	15.90	16.12	−.22	−.20	+.01	+.10	
	4 9 45	77.01	77.44	−0.43	+ 5	16.02	16.15	−.13	−.11	−.12	−.03	
	7 9 55	253.87	254.88	−1.01	+14	16.18	16.18	.00	+.13	−.28	−.29	
	17 9 26	15.79	15.25	+0.54	+10	10.86	10.91	−.05	−.01	+.10	+.07	
	18 9 25	288.21	289.70	−1.49	+10	13.00	12.94	+.06	+.17	−.34	−.37	
	19 9 25	245.79	246.35	−0.56	+ 8	15.94	15.88	+.06	+.20	−.16	−.16	
	1898–99											
Lick:	Oct. 14 19 27	144.3	143.28	+1.02	0	11.02	10.94	+.08	+.24	+.19	−.26	A. N. Vol. 149,
Aitken.	16 18 13	44.8	44.94	−0.14	+ 1	13.89	14.01	−.12	−.09	−.03	−.03	374.
	23 17 22	316.2	314.99	+1.21	0	10.97	11.43	−.46	−.14	+.24	+.30	
	Nov. 5 17 32	249.5	251.31	−1.81	0	16.83	16.76	+.07	+.22	−.53	−.01	
	11 14 40	249.5	251.12	−1.62	− 1	16.97	16.79	+.18	+.33	−.47	+.05	
	12 17 12	189.8	188.98	+0.82	0	11.55	11.09	+.46	+.24	+.16	−.01	
	15 17 29	2.9	2.37	+0.53	− 1	10.66	10.83	−.17	−.07	+.10	−.01	
	20 15 16	62.2	62.72	−0.52	+ 1	15.85	16.32	−.47	−.29	−.15	−.09	
	Dec. 2 14 36	52.9	53.14	−0.24	0	15.10	15.36	−.26	−.17	−.06	−.02	
	3 15 10	337.3	336.26	+1.04	− 1	10.17	10.64	−.47	−.24	+.19	+.13	
	9 14 47	326.7	326.22	+0.48	0	10.64	10.91	−.27	+.01	+.09	+.08	
	11 14 12	223.4	224.79	−1.39	0	14.60	14.37	+.23	+.09	−.35	−.05	
	Feb. 11 16 16	21.2	21.03	+0.17	0	11.55	11.78	−.23	−.19	+.03	−.03	
	1898–99											
Lick:	Oct. 27 17 20	79.2	78.81	+0.39	+ 9	16.69	16.75	−.06	−.12	+.11	+.16	A. J. XX, 71.
Hussey.	28 17 23	32.5	32.19	+0.31	0	12.77	12.70	+.07	+.01	+.07	+.16	
	Nov. 17 16 26	242.55	243.27	−0.72	− 1	16.19	16.34	−.15	−.26	−.21	−.12	
	Dec. 7 12 3	92.5	92.88	−0.38	0	15.32	15.81	−.49	−.54	−.10	−.07	
	15 19 45	297.8	299.66	−1.86	0	12.88	12.67	+.21	+.12	−.41	−.33	
	16 12 31	264.2	264.27	−0.07	+10	17.12	16.62	+.50	+.40	−.02	+.08	
	23 13 0	211.5	213.39	−1.89	+ 8	13.28	13.04	+.24	+.13	−.43	−.37	
	Jan. 5 11 59	111.6	112.69	−1.09	+ 6	13.01	13.31	−.30	−.35	−.25	−.25	
	12 12 4	62.8	63.28	−0.48	+ 8	16.80	16.46	+.34	+.28	−.14	−.07	
	20 12 23	275.4	275.29	+0.11	+ 7	15.40	15.27	+.13	+.03	+.03	+.12	
	26 12 23	271.2	269.77	+1.43	----	----	15.82	----	----	+.39	+.48	
	Feb. 10 15 4	73.0	73.09	−0.09	+ 3	16.93	16.70	+.23	+.17	−.03	+.03	
	16 14 19	69.5	69.60	−0.10	+ 8	16.75	16.59	+.16	+.10	−.03	+.03	
	1898											
Lowell:	Sept. 9 18 45	306.24	124.62	+1.62	0	11.86	11.94	−.08	−.07	+.34	+.34	A. J. XX, 30.
Drew.	12 18 36	120.90	300.74	+0.16	− 4	12.53	12.30	+.23	+.06	+.03	+.25	All observed
	14 18 13	23.84	204.21	−0.37	+ 1	12.29	11.68	+.61	+.35	−.08	−.15	position
	18 18 16	113.01	293.77	−0.76	0	13.37	13.08	+.29	+.11	−.17	+.05	angles as-
	19 18 28	68.71	249.34	−0.63	− 2	16.42	16.26	+.16	−.15	−.18	−.01	sumed 180°
	22 17 53	246.94	67.95	−1.01	− 1	16.34	16.20	+.14	−.01	−.29	−.05	wrong.
	27 18 24	281.86	103.32	−1.46	+ 1	14.51	14.36	+.15	+.12	−.37	−.25	
	29 18 4	176.18	358.23	−2.05	+ 1	10.37	10.47	−.10	−.21	−.38	−.19	
	Oct. 17 18 5	142.25	322.95	−0.70	+ 1	11.32	10.97	+.35	+.21	−.13	+.07	
	21 18 2	262.08	82.48	−0.40	+ 2	16.57	16.57	.00	−.11	−.12	+.10	
	Nov. 9 19 3	187.97	7.51	+0.46	+ 1	10.54	11.01	−.47	−.58	+.09	+.29	
	Dec. 7 16 24	263.58	85.30	−1.72	0	16.84	16.54	+.30	+.20	−.50	−.29	

Table I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks
		O	C	O−C		O	C	O−C	v	O−C	v	
	1899 h m	°	°	°	m	"	"	"	"	"	"	
Pulkowa:	Feb. 4 5 21	93.06	94.52	−1.46	....	15.31	15.19	+.12	+.18	−.39	−.02	A.N. Vol. 152,
Photographs.	Mar. 6 4 32	70.02	71.02	−1.00	....	16.43	16.46	−.03	+.09	−.29	−.08	277.
	7 2 32	26.35	26.85	−0.50	....	11.49	12.14	−.65	−.37	−.11	−.04	
	8 2 38	297.90	298.98	−1.08	....	11.68	12.13	−.45	−.27	−.23	+.06	
	10 2 34	201.60	202.29	−0.69	....	11.41	11.71	−.30	+.06	−.14	−.02	
	15 2 59	246.47	246.45	+0.02	....	15.99	16.22	−.23	−.05	+.01	+.13	
	16 2 54	190.32	191.33	−1.01	....	10.85	10.91	−.06	+.31	−.19	−.02	
	1899–1900											
Lick:	Nov. 30 19 28	101.7	101.89	−0.19	+ 8	15.28	15.15	+.13	−.13	−.05	−.13	Lick Observ-
Hussey.	Dec. 6 19 29	96.0	96.06	−0.06	+12	16.19	15.82	+.37	+.09	−.02	−.10	atory Bul-
	Jan. 3 12 1	222.2	222.52	−0.32	+11	14.46	13.88	+.58	+.17	−.08	−.21	letin No. 17.
	11 11 30	79.4	79.05	+0.35	+10	17.23	16.88	+.35	+.12	+.10	+.04	
	18 11 19	24.7	24.39	+0.31	+ 5	12.00	12.07	−.07	−.25	+.07	+.11	
	19 11 40	297.0	297.09	−0.09	+ 5	13.36	13.09	+.27	−.08	−.02	+.12	
	25 15 53	280.6	280.45	+0.15	+ 7	15.68	14.98	+.70	+.28	+.04	+.14	
	Mar. 28 12 43	93.4	92.96	+0.44	+ 7	15.41	15.28	+.13	−.14	+.12	+.05	
	1899–1900											
Pulkowa:	Nov. 25 7 20	85.95	85.80	+0.15	....	16.66	16.68	−.02	+.16	+.04	+.13	A. N. Vol. 157,
Photographs.	30 6 47	133.26	134.91	−1.65	....	11.15	11.77	−.62	−.27	−.34	−.20	287.
	Feb. 24 2 13	278.95	278.10	+0.85	....	14.89	14.95	−.06	−.01	+.22	+.06	
	Mar. 11 1 57	85.44	85.28	+0.16	....	15.77	16.08	−.31	−.15	+.04	+.13	
	20 1 52	258.77	258.21	+0.56	....	16.33	16.34	−.01	+.07	+.16	−.20	
	24 2 6	25.93	26.70	−0.77	....	11.66	11.92	−.26	+.09	−.16	−.11	
	25 1 52	301.05	300.60	+0.45	....	12.25	12.23	+.02	+.09	+.10	+.13	
	1899–1900											
Yerkes:	Aug. 12 17 32	27.90	28.63	−0.73	....	......	11.76	......	......	−.15	−.11	A. J. XXII, 27.
Barnard.	13 17 36	302.66	302.11	+0.55	+ 8	12.15	12.26	−.11	−.04	+.12	+.18	
	14 17 35	255.35	255.41	−0.06	+ 8	15.74	16.07	−.33	−.27	−.02	+.06	
	15 17 43	203.51	203.42	+0.09	+ 7	11.29	11.34	−.05	+.07	+.02	+.14	
	16 17 45	116.32	117.79	−1.47	....	......	12.68	......	......	−.32	−.09	
	18 17 22	197.30	19.65	−2.35	+10	10.95	11.09	−.14	−.12	−.46	−.43	Observed po-
	18 17 41	197.63	18.58	−0.95	+ 6	11.13	11.04	+.09	+.11	−.18	−.15	sition angle,
	19 17 15	294.26	295.29	−1.03	+ 8	12.80	13.00	−.20	−.13	−.23	−.16	Aug. 18, as-
	20 17 13	251.62	251.23	+0.39	+11	16.02	15.95	+.07	+.13	+.11	+.19	sumed 180°
	20 17 48	250.00	250.25	−0.25	+ 6	16.04	15.90	+.14	+.20	−.07	+.01	wrong.
	21 17 28	192.65	194.12	−1.47	+13	10.56	10.79	−.23	−.11	−.28	−.14	
	22 17 7	112.05	111.99	+0.06	+12	13.54	13.40	+.14	+.12	+.01	+.24	
	26 17 11	246.70	246.32	+0.38	+ 9	15.41	15.67	−.26	−.19	+.10	+.18	
	27 17 35	181.19	182.49	−1.30	+ 7	10.24	10.40	−.16	−.05	−.24	−.08	
	28 16 44	104.72	106.22	−1.50	+12	14.06	14.12	−.06	−.09	−.37	−.14	
	28 18 3	101.83	103.53	−1.70	+ 8	14.60	14.43	+.17	+.14	−.43	−.20	
	29 17 23	......	......	......	+ 8	15.32	15.43	−.11	−.12	......	......	
	Sept. 3 17 35	97.93	98.61	−0.68	+ 9	15.32	15.02	+.30	+.27	−.18	+.04	
	4 17 2	57.55	58.66	−1.11	+17	15.33	14.97	+.36	+.35	−.29	−.19	
	6 16 39	278.15	277.61	+0.54	+ 9	14.79	15.16	−.37	−.31	+.14	+.22	
	8 17 17	158.70	159.93	−1.23	+10	10.34	10.39	−.05	+.02	−.22	−.01	
	8 17 55	156.77	157.41	−0.64	+ 9	10.20	10.43	−.23	−.16	−.12	+.09	
	10 17 41	50.60	51.46	−0.86	+ 8	14.12	14.21	−.09	−.09	−.21	−.13	
	11 17 29	332.77	333.27	−0.50	+10	10.42	10.57	−.15	−.09	−.09	−.06	
	12 17 30	270.35	270.80	−0.45	+ 8	15.58	15.85	−.27	−.21	−.12	−.03	
	18 16 39	268.26	267.27	+0.99	+ 3	16.08	16.15	−.07	−.01	+.28	+.37	
	24 15 46	263.25	263.87	−0.62	+ 6	16.32	16.37	−.05	+.01	−.18	−.09	
	25 16 41	216.40	216.09	+0.31	+ 8	12.81	12.63	+.18	+.29	+.07	+.17	
	26 16 23	129.53	131.04	−1.51	+ 7	11.94	11.86	+.08	+.10	−.31	−.07	
	30 16 29	258.12	257.93	+0.19	+11	16.59	16.51	+.08	+.14	+.05	+.13	
	Oct. 1 16 8	209.18	209.18	0.00	+12	11.93	12.03	−.10	+.02	.00	+.11	
	2 16 41	119.92	121.54	−1.62	+10	12.86	12.75	+.11	+.11	−.36	−.12	
	7 16 6	199.52	199.83	−0.31	+ 6	11.38	11.42	−.04	+.08	−.06	+.07	
	8 16 46	112.42	113.72	−1.30	+ 7	13.66	13.59	+.07	+.05	−.31	−.07	
	9 17 7	69.29	69.61	−0.32	+ 9	16.16	16.28	−.12	−.14	−.09	+.05	
	14 17 50	103.66	104.73	−1.07	0	14.85	14.66	+.19	+.16	−.27	−.04	
	15 14 11	67.39	69.57	−2.18	+ 8	16.16	16.33	−.17	−.19	−.62	−.48	
	17 15 30	286.36	286.54	−0.18	+ 6	14.34	14.49	−.15	−.09	−.05	+.03	
	21 17 12	58.66	59.00	−0.34	+ 2	15.15	15.43	−.28	−.29	−.09	+.02	
	23 14 42	282.00	282.06	−0.06	+11	14.80	15.06	−.26	−.20	−.02	+.06	
	28 16 0	340.13	340.60	−0.47	+ 6	10.35	10.66	−.31	−.25	−.09	−.07	
	29 13 59	277.42	277.69	−0.27	+ 7	15.56	15.57	−.01	+.05	−.07	+.01	
	30 15 29	233.61	233.64	−0.03	+ 8	14.86	14.89	−.03	+.06	−.01	+.07	
	Nov. 4 14 7	271.63	272.07	−0.44	+ 7	15.79	16.15	−.36	−.30	−.12	−.03	
	5 15 39	226.39	226.93	−0.54	+ 7	14.06	14.14	−.08	+.02	−.13	−.04	
	6 13 45	150.81	152.15	−1.34	+ 9	10.81	10.90	−.09	−.03	−.25	−.03	
	7 14 38	88.31	88.62	−0.31	+ 8	16.54	16.45	+.09	+.06	−.09	+.11	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1899-1900 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes: Barnard.	Nov.11 13 10	225.60	225.84	−0.24	+ 8	13.96	14.05	−.09	+.01	−.06	+.03	
	12 15 35	134.76	134.93	−0.17	+ 9	11.87	11.79	+.08	+.11	−.03	+.21	
	18 13 54	130.20	130.88	−0.68	+ 8	12.26	12.10	+.16	+.18	−.14	+.10	
	19 13 56	79.25	79.94	−0.69	+ 7	16.84	16.88	−.04	−.07	−.20	−.02	
	25 12 24	76.49	77.57	−1.08	+ 7	17.11	16.92	+.19	+.16	−.32	−.15	
	26 12 36	27.37	27.82	−0.45	+ 8	12.18	12.30	−.12	−.10	−.10	−.06	
	27 12 46	301.23	301.15	+0.08	+ 7	12.72	12.96	−.24	−.17	+.02	+.08	
	Dec. 4 11 45	251.57	251.36	+0.21	+ 6	17.09	16.80	+.29	+.36	+.06	+.15	
	Mar.30 10 8	346.29	346.59	−0.30	+ 6	10.20	10.19	+.01	+.07	−.05	−.03	
	31 9 31	275.20	276.14	−0.94	+ 6	14.98	14.92	+.06	+.12	−.24	−.16	
	Apr. 2 9 43	160.87	162.24	−1.37	+ 6	10.26	10.18	+.08	+.17	−.24	−.04	
	3 9 41	92.74	93.15	−0.41	− 5	15.26	15.19	+.07	+.03	−.11	+.10	
	4 10 3	51.02	51.55	−0.53	+ 3	14.32	14.47	−.15	−.15	−.13	−.05	
	6 9 17	270.06	271.17	−1.11	+ 5	15.29	15.41	−.12	−.06	−.30	−.22	
	7 9 19	228.23	230.05	−1.82	+ 7	14.38	14.24	+.14	+.23	−.45	−.37	
	9 9 13	88.62	88.72	−0.10	+ 7	15.99	15.61	+.38	+.34	−.03	+.17	
	10 9 16	46.88	47.03	−0.15	+10	13.66	13.84	−.18	−.18	−.04	+.03	
	18 9 36	259.28	260.79	−1.51	+ 9	15.82	16.04	−.22	−.16	−.42	−.34	
	19 9 30	214.45	215.87	−1.42	+ 1	12.78	12.57	+.21	+.32	−.31	−.21	
	22 9 48	32.51	30.43	+2.08	+ 6	11.96	12.06	−.10	−.08	+.44	+.48	
	22 10 0	31.50	30.98	+0.52	+ 5	11.78	12.01	−.23	−.21	+.11	+.15	
	24 9 36	255.54	256.11	−0.57	+ 7	15.84	16.07	−.23	−.17	−.16	−.08	
	26 9 33	120.34	120.74	−0.40	+ 8	12.16	12.14	+.02	+.02	−.08	+.15	
	27 9 32	74.21	73.86	+0.35	+ 6	16.34	16.03	+.31	+.29	+.10	+.25	
	30 9 36	251.37	251.41	−0.04	+ 7	15.99	15.94	+.05	+.11	−.01	+.07	
	May 4 9 41	13.29	12.19	+1.10	+ 6	10.29	10.66	−.37	−.34	+.20	+.22	
	1899–1900											
U. S. Naval Obs.: See.	Oct. 6 14 37	254.17	256.16	−1.99	0	17.08	16.55	+.53	+.23	−.58	−.43	A. N. Vol. 153, 257.
	9 14 46	72.16	73.50	−1.34	+ 2	16.81	16.50	+.31	+.12	−.39	−.14	
	10 14 59	20.90	18.54	+2.36	+ 1	11.47	11.38	+.09	.00	+.47	+.71	
	18 15 14	245.15	245.24	−0.09	+ 1	15.90	16.05	−.15	−.44	−.03	+.08	
	20 13 41	106.57	107.27	−0.70	0	14.79	14.39	+.40	+.26	−.18	+.02	
	21 13 50	61.84	65.09	−3.25	+ 1	16.80	16.05	+.75	+.58	−.91	−.67	
	24 14 58	239.09	240.40	−1.31	+ 1	15.76	15.63	+.13	−.15	−.36	−.27	
	25 13 57	173.82	174.78	−0.96	0	10.62	10.61	+.01	−.08	−.18	−.16	
	26 13 54	104.10	100.71	+3.39	− 1	15.18	15.19	−.01	−.17	+.90	+1.12	
	Nov. 1 13 17	96.24	96.23	+0.01	0	15.97	15.71	+.26	+.08	.00	+.23	
	4 13 30	273.77	273.14	+0.63	0	16.31	16.04	+.27	−.02	+.18	+.39	
	5 13 33	231.14	231.53	−0.39	0	14.87	14.72	+.15	−.11	−.10	−.04	
	6 13 7	153.73	154.59	−0.86	0	11.03	10.81	+.22	+.16	−.16	−.10	
	8 13 29	46.81	48.47	−1.66	0	14.47	14.38	+.09	−.04	−.42	−.18	
	9 12 48	329.15	330.13	−0.98	0	11.12	10.96	+.16	+.01	−.19	+.07	
	10 13 2	268.52	268.80	−0.28	0	17.00	16.44	+.56	+.26	−.08	+.12	
	12 12 33	145.82	145.57	+0.25	+ 1	11.15	11.15	.00	−.06	+.05	+.14	
	13 12 16	86.63	87.57	−0.94	0	16.58	16.53	+.05	−.14	−.27	−.02	
	20 11 56	35.75	37.99	−2.24	0	13.26	13.27	−.01	−.12	−.52	−.29	
	21 11 28	311.56	313.99	−2.43	+ 5	11.80	11.85	−.05	−.24	−.50	−.24	
	24 11 40	126.14	128.66	−2.52	0	12.26	12.25	+.01	−.07	−.54	−.40	
	26 11 6	31.39	32.23	−0.84	0	12.59	12.73	−.14	−.24	−.19	+.04	
	27 11 43	304.45	304.12	+0.33	− 1	12.57	12.64	−.07	−.29	+.07	+.32	
	28 11 53	255.41	256.00	−0.59	− 1	17.10	16.92	+.18	−.13	−.17	−.01	
	Dec. 2 11 5	20.40	23.41	−3.01	+ 1	11.21	12.00	−.79	−.88	−.63	−.39	
	3 11 58	294.39	295.49	−1.10	0	12.86	13.52	−.66	−.90	−.26	−.02	
	4 11 3	252.71	252.50	+0.21	0	17.72	16.85	+.87	+.56	+.06	+.21	
	6 10 57	113.28	114.33	−1.05	0	13.84	13.64	+.20	+.08	−.25	−.07	
	8 11 11	12.34	13.09	−0.75	+ 1	11.63	11.36	+.27	+.18	−.15	+.09	
	12 10 7	104.28	109.22	−4.94	0	14.28	14.21	+.07	−.06	−1.23	−1.03	
	15 12 22	279.64	281.20	−1.56	0	15.76	15.16	+.60	+.32	−.41	−.18	
	17 10 42	178.64	178.31	+0.33	+ 1	11.79	10.82	+.97	+.88	+.06	+.08	
	20 10 58	351.08	351.32	−0.24	+ 1	10.72	10.71	+.01	−.10	−.04	+.21	
	21 10 43	278.65	278.57	+0.08	0	16.04	15.44	+.60	+.32	+.02	+.24	
	22 10 19	238.05	238.37	−0.32	0	15.99	15.80	+.19	−.09	−.09	.00	
	24 10 47	94.23	95.61	−1.38	− 1	16.01	15.76	+.25	+.07	−.38	−.15	
	26 10 29	340.82	341.52	−0.70	− 1	10.96	10.71	+.25	+.12	−.13	+.12	
	28 9 55	------	------	------	+ 9	15.34	15.20	+.14	−.13	------	------	
	Jan. 2 8 30	272.25	271.61	+0.64	0	16.24	16.13	+.11	−.19	+.18	+.39	
	3 9 16	227.90	228.68	−0.78	0	15.10	14.68	+.42	+.17	−.20	−.14	
	4 9 18	150.75	148.85	+1.90	0	10.94	10.94	.00	−.06	+.36	+.44	
	6 9 12	44.30	45.59	−1.29	0	14.29	14.31	−.02	−.14	−.32	−.09	
	8 8 15	266.15	266.87	−0.72	0	16.92	16.51	+.41	+.11	−.21	−.02	
	8 12 9	260.35	260.45	−0.10	0	17.06	16.86	+.20	−.11	−.03	+.16	
	9 7 43	224.60	225.60	−1.00	0	14.96	14.31	+.65	+.42	−.25	−.21	
	9 11 44	215.22	215.82	−0.60	0	13.49	13.18	+.31	+.10	−.14	−.10	
	14 9 33	256.60	259.81	−3.21	0	17.42	16.84	+.58	+.27	−.94	−.76	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.			Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks.
				O	C	O−C		O	C	O−C	v	O−C	v	
	1900	h	m	°	°	°	m	″	″	″	″	″	″	
U. S. Naval Obs.: See.	Jan. 15	10	5	212.35	212.35	0.00	0	13.11	12.82	+ .29	+.11	.00	+.01	
	15	13	27	202.40	202.24	+0.16	0	12.13	11.93	+ .20	+.03	+.03	+.04	
	21	8	14	209.38	209.25	+0.13	0	12.71	12.51	+ .20	+.04	+.03	+.04	
	21	12	35	195.60	195.39	+0.21	0	11.20	11.44	− .24	−.39	+.04	+.04	
	22	7	39	122.17	124.27	−2.10	0	12.80	12.35	+ .45	+.36	−.45	−.30	
	23	8	3	75.15	75.01	+0.14	0	16.78	16.85	− .07	−.27	+.04	+.29	
	23	12	33	67.19	67.73	−0.54	0	16.54	16.59	− .05	−.24	−.16	+.09	
	26	8	43	250.13	251.55	−1.42	0	17.53	16.75	+ .78	+.48	−.41	−.27	
	27	8	35	200.20	199.00	+1.20	0	11.84	11.65	+ .19	+.07	+.24	+.24	
	27	13	21	182.00	181.72	+0.28	0	10.83	10.79	+ .04	−.07	+.05	+.06	
	29	8	9	68.13	70.05	−1.92	0	16.76	16.68	+ .08	−.11	−.56	−.32	
	29	12	32	63.27	62.74	+0.53	0	15.85	16.18	− .33	−.51	+.15	+.39	
	Feb. 1	8	21	248.56	247.29	+1.27	0	16.87	16.51	+ .36	+.06	+.37	+.50	
	2	8	53	184.80	187.56	−2.76	0	11.15	10.98	+ .17	+.06	−.53	−.52	
	9	10	2	96.20	97.31	−1.11	0	15.38	15.18	+ .20	+.04	−.29	−.06	
	13	8	29	238.18	236.72	+1.46	0	15.66	15.50	+ .16	−.11	+.39	+.47	
	14	8	38	166.55	165.31	+1.24	0	10.34	10.44	− .10	−.16	+.23	+.27	
	27	8	33	83.50	84.14	−0.64	0	16.56	16.27	+ .29	+.10	−.18	+.06	
	1900–01													
Yerkes: Barnard.	Sept. 6	16	42	253.84	252.61	+1.23	+13	16.11	16.00	+ .11	+.15	+.34	+.28	A. J. XXII, 29.
	10	17	14	7.36	7.20	+0.16	+ 8	10.83	10.62	+ .21	+.16	+.03	−.03	
	11	17	26	288.08	288.17	−0.09	+ 8	14.63	14.34	+ .29	+.37	−.02	−.11	
	13	17	27	179.81	180.64	−0.83	+ 7	10.31	10.49	− .18	−.06	−.15	−.03	
	19	16	18	172.61	173.42	−0.81	+26	10.17	10.46	− .29	−.17	−.15	−.01	
	24	15	27	240.04	238.96	+1.08	+ 9	14.72	14.90	− .18	−.12	+.28	+.23	
	25	15	44	162.41	163.84	−1.43	+11	10.31	10.56	− .25	−.15	−.26	−.09	
	Oct. 1	16	2	149.18	151.28	−2.10	+ 8	10.12	10.93	− .81	−.74	−.40	−.19	
	2	16	5	90.14	91.35	−1.21	+ 6	16.42	16.15	+ .27	+.20	−.34	−.10	
	3	16	9	46.98	47.96	−0.98	+ 7	13.82	13.73	+ .09	+.01	−.24	−.17	
	4	15	45	327.69	326.92	+0.77	+ 9	11.53	11.15	+ .38	+.41	+.15	+.03	
	5	17	4	266.95	267.23	−0.28	+ 8	16.26	16.41	− .15	−.09	−.08	−.16	
	8	16	47	84.52	85.24	−0.72	+ 8	16.57	16.51	+ .06	−.01	−.21	+.01	
	9	16	47	38.43	38.88	−0.45	+ 8	12.70	12.83	− .13	−.21	−.10	−.07	
	10	15	56	316.54	316.24	+0.30	+ 7	11.74	11.82	− .08	−.03	+.06	−.06	
	11	17	3	262.16	262.38	−0.22	+ 6	16.61	16.58	+ .03	+.08	−.06	−.13	
	16	15	11	309.62	309.44	+0.18	+ 8	12.40	12.40	.00	+.06	+.04	−.07	
	17	14	31	261.39	261.69	−0.30	+ 6	16.71	16.65	+ .06	+.11	−.09	−.16	
	18	16	20	207.37	207.21	+0.16	+ 7	11.63	11.89	− .26	−.14	+.03	+.05	
	25	14	8	119.96	120.13	−0.17	+ 8	13.67	13.34	+ .33	+.31	−.04	+.23	
	26	14	32	74.22	74.36	−0.14	+ 7	16.48	16.55	− .07	−.14	−.04	+.14	
	27	15	32	14.96	14.89	+0.07	+35	11.32	11.14	+ .18	+.12	+.01	−.04	
	30	16	28	184.26	185.93	−1.67	+10	10.80	10.88	− .08	+.05	−.32	−.22	
	Nov. 1	17	46	63.43	63.56	−0.13	+ 6	15.76	15.75	+ .01	−.06	−.04	+.10	
	2	17	52	355.35	354.67	+0.68	+ 8	10.59	10.71	− .12	−.15	+.13	+.04	
	3	14	15	289.06	289.41	−0.35	+ 6	14.34	14.56	− .22	−.14	−.09	−.19	
	4	13	21	248.85	248.80	+0.05	+ 5	16.13	16.26	− .13	−.08	+.01	−.05	
	5	14	42	180.52	181.41	−0.89	+ 9	10.49	10.80	− .31	−.18	−.17	−.05	
	8	17	41	164.78	343.68	+1.10	+ 8	10.58	10.77	− .19	−.20	+.21	+.10	Observed position angle, Nov. 8, assumed 180° wrong.
	13	14	21	58.69	58.79	−0.10	+ 6	15.64	15.33	+ .31	+.23	−.03	+.08	
	22	12	7	234.62	234.28	+0.34	+ 9	14.84	14.88	− .04	+.03	+.09	+.05	
	26	11	40	334.74	332.86	+1.88	+10	11.55	11.10	+ .45	+.47	+.36	+.24	
	Dec. 8	13	10	307.87	307.91	−0.04	+ 8	12.73	12.64	+ .09	+.16	−.01	−.13	
	11	11	4	129.31	129.78	−0.47	+ 7	12.38	12.46	− .08	−.07	−.10	+.16	
	18	11	28	74.04	74.66	−0.62	+ 7	16.80	16.86	− .06	−.14	−.18	+.01	
	19	14	18	10.68	10.71	−0.03	+ 8	11.02	11.21	− .19	−.25	−.01	−.07	
	28	14	57	171.22	171.13	+0.09	+ 8	11.19	10.77	+ .42	+.54	+.02	+.18	
	29	12	24	103.48	104.35	−0.87	+ 6	15.10	15.09	+ .01	−.05	−.23	+.04	
	31	16	50	158.10	337.73	+0.37	+ 7	10.66	10.91	− .25	−.24	+.07	−.05	
	Jan. 1	10	16	287.40	285.71	+1.69	+ 8	14.42	14.92	− .50	−.42	+.44	+.35	
	14	14	56	222.00	222.00	0.00	+11	13.58	13.63	− .05	+.05	.00	−.02	
	16	10	48	89.95	90.63	−0.68	+ 7	16.54	16.39	+ .15	+.07	−.19	+.05	
	17	9	52	49.00	50.31	−1.31	+ 7	15.22	14.58	+ .64	+.56	−.33	−.25	
	19	10	4	269.18	269.33	−0.15	+ 6	16.20	16.47	− .27	−.20	−.04	−.12	
	21	13	24	132.27	133.11	−0.84	+ 7	11.97	11.99	− .02	.00	−.18	+.08	
	25	10	58	262.73	262.86	−0.13	+ 8	16.58	16.78	− .20	−.14	−.04	−.11	
	28	10	26	81.11	81.31	−0.20	+10	16.92	16.80	+ .12	+.04	−.06	+.15	
	Feb. 5	10	36	300.48	299.65	+0.83	+ 9	12.92	13.07	− .15	−.07	+.19	+.08	
	1901													
Pulkowa: Photographs.	Jan. 24	4	58	335.88	338.36	−2.48	....	10.33	10.78	− .45	−.05	−.47	−.02	A. N. Vol. 157, 287.
	29	4	2	48.88	50.14	−1.26	....	13.99	14.57	− .58	−.09	−.32	+.15	
	Feb. 8	4	13	134.54	134.24	+0.30	....	11.16	11.76	− .60	+.18	+.06	+.10	
	14	1	47	131.60	132.54	−0.94	....	10.82	11.83	−1.01	−.23	−.19	−.13	
	22	2	4	21.76	24.34	−2.58	....	11.60	11.85	− .25	+.21	−.53	−.13	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	$s \sin dp$ O−C	$s \sin dp$ v	Remarks.
	1901–02 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes: Barnard.	Aug. 27 17 45	92.11	93.40	−1.29	+ 9	15.94	15.83	+.11	−.01	−.36	−.14	A. J. XXIII, 105.
	Sept. 3 17 31	42.05	43.06	−1.01	+ 9	12.90	12.81	+.09	−.02	−.23	−.31	
	16 17 12	302.75	302.41	+0.34	+11	12.87	13.16	−.29	−.16	+.08	+.14	
	22 17 27	295.16	294.74	+0.42	+ 7	13.56	14.01	−.45	−.34	+.10	+.19	
	23 17 28	251.58	251.75	−0.17	+ 7	15.70	15.89	−.19	−.18	−.05	+.08	
	24 16 59	190.32	191.57	−1.25	+ 9	10.56	10.84	−.28	−.18	−.24	−.09	
	Oct. 1 17 8	104.70	106.06	−1.36	+ 9	15.48	15.05	+.43	+.34	−.36	−.10	
	20 18 32	42.11	41.22	+.89	+ 7	13.27	12.94	+.33	+.23	+.20	+.11	
	21 15 34	325.18	326.19	−1.01	+ 8	11.42	11.49	−.07	+.07	−.20	−.24	
	29 15 11	218.76	218.28	+0.48	+11	12.52	12.72	−.20	−.13	+.11	+.23	
	Nov. 12 18 18	68.03	68.20	−0.17	+ 6	16.34	16.05	+.29	+.13	−.05	+.02	
	18 16 44	65.43	65.63	−0.20	+ 6	15.68	15.84	−.16	−.32	−.06	−.01	
	19 12 56	11.77	11.87	−0.10	+ 7	11.06	11.17	−.11	−.10	−.02	−.17	
	26 17 20	275.95	277.84	−1.89	+ 7	16.30	16.18	+.12	+.18	−.53	−.39	
	Dec. 10 13 33	148.45	149.86	−1.41	+ 2	11.11	11.40	−.29	−.24	−.28	−.03	
	15 11 42	229.16	228.32	+0.84	+10	13.98	14.05	−.07	−.02	+.21	+.32	
	16 13 26	138.90	140.03	−1.13	+ 7	12.21	11.96	+.25	+.28	−.24	+.03	
	17 12 9	88.45	88.71	−0.26	+ 8	17.02	16.81	+.21	+.07	−.08	+.13	
	22 10 11	138.63	141.10	−2.47	+11	11.67	11.89	−.22	−.19	−.51	−.24	
	23 11 25	84.74	84.97	−0.23	+16	16.91	16.94	−.03	−.17	−.07	+.12	
	29 11 54	78.59	79.26	−0.67	+ 8	17.14	16.92	+.22	+.07	−.20	−.05	
	30 10 17	31.13	32.51	−1.38	+10	12.79	12.52	+.27	+.19	−.30	−.42	
	Jan. 2 10 11	206.83	208.32	−1.49	+ 9	11.93	12.20	−.27	−.18	−.32	−.20	
	5 11 43	19.16	18.34	+0.82	+ 7	11.49	11.56	−.07	−.09	+.17	+.02	
	10 11 33	69.51	69.80	−0.29	+ 6	16.57	16.44	+.13	−.03	−.08	.00	
	12 10 24	291.85	291.95	−0.10	+ 5	14.02	14.47	−.45	−.33	−.03	+.07	
	13 10 3	249.83	249.81	+0.02	+ 7	16.42	16.44	−.02	−.01	+.01	+.15	
	18 9 51	286.27	286.75	−0.48	+ 5	14.82	15.02	−.20	−.10	−.13	−.01	
	24 13 41	273.06	273.86	−0.80	+ 7	16.37	16.31	+.06	+.11	−.23	−.08	
	27 9 44	97.15	98.27	−1.12	+ 8	16.30	15.88	+.42	+.31	−.31	−.06	
	31 9 30	233.19	234.00	−0.81	+ 7	14.52	14.75	−.23	−.19	−.21	−.10	
	Feb. 2 9 23	93.12	93.54	−0.42	+10	16.50	16.27	+.23	+.11	−.12	+.11	
	7 9 10	145.63	146.36	−0.73	+ 8	11.33	11.33	.00	+.05	−.14	+.12	
	8 8 46	88.66	89.47	−0.81	+ 7	16.76	16.49	+.27	+.14	−.23	−.02	
	15 8 57	37.53	37.64	−0.11	+ 7	13.12	12.89	+.23	+.13	−.02	−.12	
	17 8 38	261.50	262.32	−0.82	+ 9	16.59	16.68	−.09	−.07	−.24	−.09	
	24 8 44	204.25	205.12	−0.87	+ 7	11.71	11.80	−.09	+.01	−.18	−.06	
	25 8 40	120.49	120.50	−0.01	+ 6	13.10	13.16	−.06	−.09	.00	+.28	
	Mar. 17 10 26	341.65	339.77	+1.88	+ 8	10.22	10.62	−.40	−.28	+.35	+.25	
	18 10 12	274.38	275.21	−0.83	+ 7	15.66	15.71	−.05	+.01	−.23	−.09	
	24 9 35	270.59	271.13	−0.54	+ 8	15.99	15.99	.00	+.04	−.15	−.01	
	25 9 45	227.00	227.67	−0.67	+10	13.95	13.66	+.29	+.34	−.16	−.06	
	Apr. 6 9 32	213.17	212.80	+0.37	+ 7	12.53	12.11	+.42	+.50	+.08	+.19	
	8 9 45	78.46	78.69	−0.23	+ 7	16.24	16.21	+.03	−.12	−.07	+.03	
	13 9 40	119.12	118.83	+0.29	+ 7	13.38	13.03	+.35	+.32	+.07	+.34	
	14 9 26	73.84	74.39	−0.55	+ 7	16.15	16.03	+.12	−.03	−.15	−.04	
	15 9 34	19.58	18.41	+1.17	+ 6	10.91	11.05	−.14	−.16	+.23	+.09	
	1902											
Lick: Photographs.	Jan. 4 15 9	67.54	68.72	−1.18	....	16.46	16.37	+.09	+.10	−.34	+.14	Lick Observatory Bulletin No. 39.
	6 13 54	290.83	290.78	+0.05	....	14.58	14.62	−.04	+.10	+.01	+.09	
	7 14 20	247.82	247.50	+0.32	....	16.27	16.26	+.01	+.01	+.09	+.03	
	8 12 41	189.69	189.52	+0.17	....	10.88	11.18	−.30	−.21	+.03	−.12	
	9 12 36	109.75	110.38	−0.63	....	14.44	14.65	−.21	+.03	−.16	+.15	
	11 17 22	346.20	345.40	+0.80	....	10.86	10.88	−.02	−.10	+.15	+.17	
	12 13 46	284.96	284.83	+0.13	....	15.08	15.27	−.19	−.05	+.03	−.04	
	16 16 4	53.06	55.73	−2.67	....	14.91	15.02	−.11	−.07	−.70	−.26	
	1901–02											
Lick: Aitken.	Sept. 6 19 54	209.80	211.96	−2.16	0	12.00	11.87	+.13	+.21	−.45	−.02	Lick Observatory Bulletin No. 51.
	8 19 36	79.95	80.53	−0.58	0	16.46	16.23	+.23	+.23	−.16	−.07	
	14 19 16	75.85	76.19	−0.34	0	16.16	16.12	+.04	+.05	−.10	−.01	
	28 19 7	284.85	285.08	−0.23	0	14.85	15.11	−.26	−.15	−.06	+.09	
	Oct. 5 17 57	237.65	239.86	−2.21	0	14.72	14.87	−.15	+.03	−.57	−.18	
	8 17 42	56.85	57.31	−0.46	0	14.40	14.61	−.21	−.22	−.12	−.04	
	12 18 9	152.55	152.75	−0.20	0	11.30	11.10	+.20	+.04	−.04	+.24	
	19 17 15	89.70	89.95	−0.25	0	16.60	16.51	+.09	+.07	−.07	+.02	
	Nov. 12 15 30	72.40	73.11	−0.71	0	16.17	16.47	−.30	−.29	−.20	−.11	
	16 15 55	182.65	186.10	−3.45	0	11.01	11.00	+.01	−.04	−.66	−.25	
	Dec. 20 18 6	256.15	256.43	−0.28	0	17.02	16.84	+.18	+.36	−.08	+.24	
	21 14 7	211.95	214.22	−2.27	0	12.48	12.69	−.21	−.11	−.50	−.05	
	Jan. 11 12 47	4.35	3.58	+0.77	0	10.73	10.99	−.26	−.28	+.15	+.18	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	h m	°	°	°	m	"	"	"	"	"	"	
	1903											
Strasburg: Wirtz.	Feb. 17 6 46	239.94	239.52	+0.42	0	14.81	15.09	−.28	−.12	+ .11	−.50	A. N. Vol. 169, 35.
	18 6 20	166.74	166.55	+0.19	0	11.44	10.80	+.64	+.93	+ .04	+.08	
	19 5 48	99.23	100.44	−1.21	0	15.63	15.72	−.09	−.14	− .33	−.13	
	20 5 32	60.06	59.03	+1.03	0	14.83	15.01	−.18	−.27	+ .27	+.24	
	24 5 22	158.10	158.90	−0.80	0	10.30	10.93	−.63	−.37	− .15	−.05	
	26 5 39	53.55	52.52	+1.03	0	13.89	14.25	−.36	−.47	+ .26	+.19	
	Mar. 12 4 37	269.46	264.64	+4.82	0	17.18	16.49	+.69	+.86	+1.39	+.68	
	17 5 35	306.64	304.36	+2.28	0	12.29	12.93	−.64	−.49	+ .52	−.16	
	21 4 43	75.12	77.17	−2.05	0	16.60	16.30	+.30	+.24	− .58	−.50	
	23 4 42	302.64	299.10	+3.54	0	13.03	13.43	−.40	−.22	+ .83	+.14	
	1902–03											
Yerkes: Barnard.	Aug. 25 17 56	183.85	184.86	−1.01	+ 7	10.23	10.49	−.26	−.25	− .18	−.02	A. J. XXIII, 107.
	Sept. 1 17 10	104.17	105.64	−1.47	+ 7	15.44	15.08	+.36	+.27	− .39	−.09	
	8 18 11	54.54	55.31	−0.77	+10	14.12	13.84	+.28	+.09	− .19	−.06	
	9 17 12	338.97	338.74	+0.23	+ 9	10.76	10.83	−.07	−.08	+ .04	−.07	
	15 17 10	329.09	328.21	+0.88	+11	11.56	11.34	+.22	+.25	+ .17	+.07	
	16 17 3	273.21	272.81	+0.40	+ 8	15.94	16.18	−.24	−.21	+ .11	+.22	
	18 17 30	141.42	142.18	−0.76	+11	11.72	11.75	−.03	−.05	− .16	+.08	
	30 16 34	126.34	127.56	−1.22	+ 7	13.18	13.02	+.16	+.12	− .28	−.01	
	Oct. 6 17 32	116.72	117.99	−1.27	+ 7	14.36	14.10	+.26	+.20	− .31	−.02	
	7 15 9	77.34	78.79	−1.45	+11	16.41	16.27	+.14	−.02	− .41	−.14	
	13 16 56	69.44	70.48	−1.04	+ 9	16.08	15.71	+.37	+.19	− .29	−.06	
	14 16 42	5.37	4.90	+0.47	+10	11.23	10.79	+.44	+.34	+ .09	−.01	
	27 19 2	273.98	275.06	−1.08	+ 9	16.79	16.44	+.35	+.39	− .31	−.20	
	Nov. 24 13 2	30.54	30.29	+0.25	+ 7	12.15	12.10	+.05	−.13	+ .05	+.04	
	Dec. 1 16 51	289.37	290.47	−1.10	+ 7	15.00	15.19	−.19	−.11	− .29	−.25	
	30 11 20	332.34	331.16	+1.18	+11	11.83	11.54	+.29	+.31	+ .24	+.13	
	Jan. 12 11 53	261.86	262.18	−0.32	+ 9	16.74	16.90	−.16	−.16	− .09	+.05	
	19 11 27	202.34	202.79	−0.45	+ 8	11.59	11.72	−.13	−.13	− .09	+.06	
	20 9 49	123.08	123.98	−0.90	+ 7	13.19	13.46	−.27	−.31	− .21	+.08	
	Feb. 2 14 28	239.03	58.96	+0.07	----	----	15.09	----	----	+ .02	+.18	Observed position angle, Feb. 2, assumed 180° wrong.
	9 11 22	344.22	344.10	+0.12	+10	10.77	10.90	−.13	−.15	+ .02	−.10	
	16 10 43	272.99	274.33	−1.34	+10	15.96	16.30	−.34	−.29	− .38	−.27	
	17 10 31	231.00	231.49	−0.49	+ 6	13.90	14.17	−.27	−.29	− .12	+.03	
	23 10 38	223.58	224.10	−0.52	+ 8	13.25	13.32	−.07	−.09	− .12	+.02	
	24 11 35	136.30	137.02	−0.72	+ 8	12.00	12.03	−.03	−.05	− .15	+.11	
	Mar. 2 10 11	132.06	132.27	−0.21	+ 8	12.53	12.36	+.17	+.14	− .05	+.21	
	25 10 11	175.82	176.14	−0.32	+10	10.60	10.55	+.05	+.07	− .06	+.12	
	30 11 53	235.44	235.74	−0.30	+ 7	14.34	14.32	+.02	.00	− .08	+.07	
	1902–03											
U. S. Naval Obs.: Dinwiddie.	Oct. 24 17 33	101.99	100.24	+1.75	0	16.28	16.04	+.24	+.29	+ .49	+.29	A. J. XXIII, 144.
	28 17 20	235.03	234.68	+0.35	0	14.39	14.18	+.21	+.17	+ .09	+.28	
	29 17 46	154.10	152.55	+1.55	0	11.39	11.39	.00	−.01	+ .31	+.21	
	30 17 19	96.33	95.45	+0.88	+ 1	16.05	16.43	−.38	−.33	+ .25	+.04	
	31 17 49	50.96	50.04	+0.92	0	13.68	13.73	−.05	+.16	+ .22	+.10	
	Nov. 1 17 8	327.27	329.62	−2.35	0	11.88	11.53	+.35	+.47	− .47	−.01	
	2 17 9	272.43	273.22	−0.79	0	16.51	16.57	−.06	−.19	− .23	+.19	
	21 15 50	205.87	205.95	−0.08	+ 2	11.74	11.80	−.06	−.11	− .02	+.04	
	Dec. 1 15 13	291.17	293.95	−2.78	+ 1	15.34	14.74	+.60	+.48	− .71	−.19	
	5 15 22	69.20	68.31	+0.89	+ 2	15.93	15.99	−.06	+.05	+ .25	+.05	
	7 14 41	286.28	288.85	−2.57	+ 2	15.62	15.31	+.31	+.18	− .69	−.19	
	Jan. 6 12 16	263.97	266.50	−2.53	0	16.48	16.92	−.44	−.57	− .75	−.36	
	22 11 12	19.61	18.54	+1.07	+ 1	10.86	11.51	−.65	−.34	+ .22	+.34	
	Feb. 20 9 7	52.00	51.33	+0.67	0	13.57	14.15	−.58	−.38	+ .17	+.04	
	22 9 34	269.53	271.19	−1.66	0	16.55	16.43	+.12	−.03	− .48	−.06	
	25 9 41	88.07	88.53	−0.46	0	16.88	16.53	+.35	+.41	− .13	−.34	
	26 9 8	43.24	44.14	−0.90	+ 1	13.17	13.34	−.17	+.07	− .21	−.29	
	Mar. 3 8 38	84.92	85.37	−0.45	+ 1	16.77	16.56	+.21	+.28	− .13	−.34	
	12 8 30	257.50	258.24	−0.74	0	15.97	16.42	−.45	−.56	− .21	+.11	
	17 8 34	295.24	296.92	−1.68	0	13.46	13.71	−.25	−.35	− .40	+.12	
	18 8 53	251.43	252.61	−1.18	0	16.45	16.08	+.37	+.28	− .33	−.05	
	26 8 41	108.42	106.94	+1.48	+ 1	14.79	14.74	+.05	+.11	+ .38	+.19	
	1903											
Yerkes: Barnard.	Aug. 31 18 28	119.97	121.77	−1.80	+ 4	13.99	13.63	+.36	+.26	− .43	−.12	A. J. XXV, 41.
	Sept. 21 16 58	283.56	283.83	−0.27	+ 6	15.62	15.66	−.04	+.02	− .07	−.05	
	28 16 32	235.59	235.40	+0.19	+ 7	13.48	13.74	−.26	−.16	+ .05	+.15	
	Oct. 13 15 14	308.99	39.20	−0.21	+ 8	12.33	12.31	+.02	−.07	− .05	−.09	Observed position angle, Oct. 13, assumed 270° too large.
	19 16 37	24.00	25.21	−1.21	+ 8	11.60	11.44	+.16	+.10	− .24	−.32	
	20 13 33	312.51	311.29	+1.22	+ 7	13.08	13.10	−.02	+.06	+ .28	+.24	
	26 16 48	296.46	296.43	+0.03	+ 7	14.54	14.70	−.16	−.08	+ .01	.00	
	27 15 33	256.16	255.99	+0.17	+ 7	15.88	16.10	−.22	−.16	+ .05	+.11	

Table I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1903–04 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes: Barnard.	Nov. 9 14 43	171.58	173.34	−1.76	+ 9	10.92	10.95	−.03	+.04	−.34	−.05	
	21 16 7	146.41	146.87	−0.46	+ 9	12.11	11.99	+.12	+.10	−.10	+.23	
	24 14 27	328.18	327.54	+0.64	+ 8	12.18	11.95	+.23	+.30	+.13	+.05	
	Dec. 14 12 35	203.89	205.58	−1.69	+ 8	11.33	11.77	−.44	−.31	−.35	−.15	
	21 13 39	113.14	114.24	−1.10	+ 6	15.24	15.02	+.22	+.10	−.29	+.02	
	22 11 36	105.70	75.33	+0.37	+ 6	16.92	16.45	+.47	+.34	+.11	+.24	Observed position angle, Dec. 22, assumed 30° too large.
	Jan. 3 15 49	54.80	55.18	−0.38	+ 6	14.15	14.40	−.25	−.37	−.10	−.08	
	19 9 31	149.70	151.12	−1.42	+12	11.00	11.65	−.65	−.65	−.29	+.04	
	26 13 50	81.54	81.86	−0.32	+ 5	17.11	16.78	+.33	+.19	−.09	+.08	
	Feb. 2 10 54	28.46	28.15	+0.31	+ 8	12.02	11.92	+.10	+.03	+.06	−.01	
	15 13 33	284.49	285.84	−1.35	+ 6	15.40	15.54	−.14	−.06	−.37	−.36	
	16 13 34	242.44	243.70	−1.26	+ 7	15.42	15.28	+.14	+.23	−.34	−.26	
	Apr. 4 9 50	186.43	186.87	−0.44	+ 6	10.86	10.69	+.17	+.28	−.08	+.16	
	18 10 38	54.70	55.08	−0.38	+ 6	13.92	13.84	+.08	−.03	−.09	−.07	
	19 11 10	335.18	333.20	+1.98	+ 6	10.62	11.00	−.38	−.32	+.38	+.29	
	1904											
Yerkes: Barnard.	Oct. 15 15 52	153.39	154.89	−1.50	+12	11.64	11.55	+.09	−.04	−.30	−.02	A. J. XXV, 42.
	17 15 38	231.25	53.53	−2.28	+ 7	13.95	13.44	+.51	+.36	−.54	−.37	Observed position angle, Oct. 17, assumed 180° wrong.
	22 18 30	88.41	89.22	−0.81	+ 6	16.86	16.57	+.29	+.11	−.23	+.01	
	29 14 58	38.20	38.89	−0.69	+ 6	12.26	12.24	+.02	−.14	−.15	−.02	
	31 15 26	266.71	266.87	−0.16	+ 7	16.39	16.59	−.20	−.27	−.05	−.01	
	Nov. 5 13 18	311.32	311.54	−0.22	+10	13.32	13.46	−.14	−.25	−.05	−.07	
	12 15 20	257.72	256.70	+1.02	+ 6	16.07	16.07	.00	−.05	+.29	+.36	
	14 15 40	115.02	115.86	−0.84	+ 6	15.58	15.15	+.43	+.22	−.22	+.05	
	21 13 47	71.06	71.26	−0.20	+ 6	15.86	15.63	+.23	+.07	−.05	+.16	
	26 13 47	107.28	107.95	−0.67	+ 6	16.12	15.98	+.14	−.07	−.19	+.08	
	28 15 17	343.27	343.90	−0.63	+ 5	11.44	11.33	+.11	−.04	−.12	−.11	
	Dec. 5 13 10	280.25	281.01	−0.76	+ 6	16.30	16.55	−.25	−.34	−.22	−.21	
	10 13 33	328.81	329.39	−0.58	+ 5	12.26	12.05	+.21	+.08	−.12	−.13	
	12 14 22	226.08	226.18	−0.10	+ 7	13.33	13.13	+.20	+.20	−.02	+.14	
	31 11 21	125.21	126.18	−0.97	+ 6	14.40	14.00	+.40	+.20	−.24	+.04	
	1904–05											
U. S. Naval Obs.: Hammond.	Nov. 21 16 43	65.05	65.37	−0.32	0	14.86	15.03	−.17	−.09	−.08	+.08	A. J. XXIV, 189.
	30 15 43	235.91	237.74	−1.83	0	14.40	14.26	+.14	+.09	−.46	−.22	
	Dec. 14 12 24	93.70	94.66	−0.96	0	16.16	16.86	−.70	−.59	−.28	−.22	
	16 11 55	325.04	325.17	−0.13	0	12.53	12.31	+.22	+.19	−.03	+.16	
	18 12 29	221.68	223.20	−1.52	0	13.03	12.92	+.11	+.02	−.34	−.16	
	19 11 38	141.52	141.49	+0.03	0	12.79	12.58	+.21	+.21	+.01	−.05	
	29 10 51	264.50	264.69	−0.19	0	17.33	16.84	+.49	+.51	−.06	+.22	
	Jan. 1 10 30	81.53	82.74	−1.21	0	16.69	16.77	−.08	+.03	−.35	−.24	
	Mar. 13 8 45	63.57	64.52	−0.95	0	14.84	14.98	−.14	−.06	−.25	−.09	
	25 9 21	50.26	49.84	+0.42	0	13.36	13.32	+.04	+.10	+.10	+.28	
	31 9 51	41.26	40.48	+0.78	0	11.96	12.41	−.45	−.41	+.17	+.35	
	1905											
U. S. Naval Obs.: Rice.	Jan. 16 10 39	247.77	249.05	−1.28	0	16.01	15.69	+.32	+.10	−.35	−.06	A. J. XXIV, 189.
	27 10 33	280.36	280.50	−0.14	0	16.90	16.42	+.48	+.17	−.04	+.19	
	Feb. 7 9 38	324.89	324.61	+0.28	0	12.28	12.12	+.16	−.01	+.06	+.16	
	10 9 26	139.54	140.62	−1.08	0	12.67	12.38	+.29	−.13	−.23	−.04	
	24 9 26	21.76	21.54	+0.22	0	11.36	11.41	−.05	−.23	+.04	−.04	
	Mar. 10 10 5	242.92	244.82	−1.90	0	15.21	15.03	+.18	−.02	−.50	−.21	
	1905–06											
Yerkes: Barnard.	Dec. 9 18 44	341.68	340.53	+1.15	+ 7	11.61	11.62	−.01	+.07	+.23	+.19	A. J. XXV, 100.
	16 16 53	277.84	280.20	−2.36	----	------	16.75	------	------	−.69	−.16	
	19 13 9	102.60	104.09	−1.49	+14	17.07	16.55	+.52	+.25	−.43	−.21	
	23 17 21	223.97	225.28	−1.31	+ 8	13.35	12.88	+.47	+.20	−.30	+.05	
	26 13 10	52.78	52.68	+0.10	− 1	13.99	13.61	+.38	−.01	+.02	−.08	
	30 15 46	137.18	137.36	−0.18	+ 7	13.03	13.20	−.17	−.32	−.04	+.12	
	Jan. 23 13 25	115.45	115.00	+0.45	+ 8	16.01	15.40	+.61	+.41	+.12	+.33	
	Feb. 6 14 8	337.87	338.00	−0.13	+ 5	11.42	11.58	−.16	−.07	−.03	−.05	
	27 11 45	132.00	133.33	−1.33	+ 7	13.40	13.20	+.20	+.06	−.31	−.15	
	Mar. 20 11 5	290.16	291.32	−1.16	+ 7	15.03	15.29	−.26	−.30	−.31	+.13	
	Apr. 17 9 17	41.19	41.10	+0.09	+ 5	12.02	12.13	−.11	−.42	+.02	−.14	
	1905–06											
U. S. Naval Obs.: Hammond.	Oct. 29 14 37	343.64	342.96	+0.68	0	11.36	11.36	.00	−.04	+.13	+.34	A. J. XXV, 94.
	30 14 27	283.48	284.16	−0.68	0	16.52	16.33	+.19	+.23	−.19	+.07	
	Nov. 1 13 45	162.36	160.80	+1.56	+ 1	11.46	11.47	−.01	+.07	+.31	+.30	
	Jan. 5 12 58	136.46	136.96	−0.50	0	12.77	13.18	−.41	−.25	−.12	−.04	
	6 11 23	91.10	91.80	−0.70	0	16.68	16.92	−.24	−.08	−.21	+.15	
	16 10 38	208.03	209.38	−1.35	+ 1	11.57	11.84	−.27	−.34	−.28	−.24	
	18 12 43	78.17	79.25	−1.08	0	16.01	16.38	−.37	−.25	−.31	+.09	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1906 h m	°	°	°	m	"	"	"	"	"	"	
U. S. Naval Obs.: Hammond.	Jan. 24 9 47	78.17	79.16	−0.99	−8	16.13	16.38	−.25	−.13	−.28	+.12	
	24 11 47	74.06	75.52	−1.46	0	15.85	16.06	−.21	−.09	−.41	−.01	
	28 11 48	184.01	183.36	+0.65	+1	10.93	11.07	−.14	−.14	+.13	+.11	
	29 9 29	115.24	116.98	−1.74	0	15.16	15.12	+.04	+.23	−.46	−.24	
	29 12 38	109.93	110.69	−0.76	0	15.64	15.78	−.14	+.05	−.21	+.01	
	31 9 36	5.73	6.25	−0.52	+1	11.43	11.08	+.35	+.31	−.10	+.15	
	31 11 53	355.88	357.44	−1.56	−2	11.34	11.07	+.27	+.23	−.30	−.05	
	Feb. 11 8 15	63.51	64.93	−1.42	+1	14.73	14.95	−.22	−.14	−.37	+.02	
	13 8 16	284.31	284.99	−0.68	0	16.43	16.16	+.27	+.32	−.19	+.08	
	13 11 26	278.23	279.42	−1.19	+6	16.56	16.55	+.01	+.06	−.34	−.07	
	16 8 44	100.01	101.53	−1.52	+1	16.00	16.39	−.39	−.21	−.43	−.12	
	16 10 33	96.87	98.39	−1.52	0	16.61	16.56	+.05	+.23	−.44	−.13	
	17 8 39	56.02	57.45	−1.43	0	13.96	14.11	−.15	−.09	−.35	+.03	
	19 8 44	277.30	278.95	−1.65	+1	16.49	16.51	−.02	+.02	−.48	−.21	
	23 8 28	48.45	50.58	−2.13	+1	13.36	13.37	−.01	+.02	−.50	−.14	
	23 10 58	42.83	43.74	−0.91	0	12.92	12.75	+.17	+.20	−.20	+.16	
	24 10 54	318.51	319.86	−1.35	0	12.46	12.61	−.15	−.14	−.30	−.09	
	25 8 14	273.28	274.74	−1.46	+11	16.88	16.63	+.25	+.28	−.42	−.15	
	25 10 38	269.68	270.72	−1.04	−1	16.21	16.67	−.46	−.43	−.30	−.03	
	Mar. 6 9 14	84.43	85.59	−1.16	+1	16.47	16.50	−.03	+.11	−.33	+.04	
	10 9 16	205.20	205.67	−0.47	0	11.41	11.45	−.04	−.10	−.09	−.06	
	20 9 2	294.46	295.42	−0.96	+1	15.02	14.85	+.17	+.21	−.25	−.01	
	23 9 26	111.08	111.64	−0.56	0	14.86	15.21	−.35	−.17	−.15	+.08	
	1906–07											
Yerkes: Barnard.	Oct. 30 17 51	251.52	251.74	−0.22	+5	14.90	14.90	.00	.00	−.06	+.20	A. J. XXV, 164.
	Nov. 13 15 12	104.10	105.92	−1.82	+10	16.70	16.46	+.24	+.28	−.52	−.31	
	Dec. 18 17 5	112.89	113.57	−0.68	+4	16.00	15.98	+.02	+.08	−.19	+.01	
	22 18 4	244.25	245.49	−1.24	+7	14.70	14.63	+.07	+.07	−.32	−.07	
	Jan. 8 12 46	282.20	282.58	−0.38	+5	16.42	16.74	−.32	−.25	−.11	+.20	
	Feb. 5 11 22	19.87	20.00	−0.13	+7	11.27	11.32	−.05	−.01	−.03	−.01	
	10 14 52	69.21	69.69	−0.48	+6	15.12	15.17	−.05	−.08	−.13	+.01	
	12 14 30	288.51	290.33	−1.82	+6	15.76	15.98	−.22	−.13	−.51	−.23	
	17 12 51	351.42	351.86	−0.44	+6	11.00	11.17	−.17	−.07	−.09	−.03	
	Mar. 3 13 58	226.59	226.93	−0.34	+6	12.89	12.76	+.13	+.12	−.08	+.10	
	5 11 57	96.44	96.57	−0.13	+5	16.52	16.59	−.07	−.05	−.04	+.17	
	10 13 1	136.50	137.37	−0.87	+6	12.80	13.02	−.22	−.15	−.20	−.05	
	26 9 58	261.14	262.29	−1.15	+7	15.93	16.02	−.09	−.06	−.32	−.03	
	Apr. 2 10 19	188.21	188.82	−0.61	+6	10.86	10.80	+.06	+.08	−.11	.00	
	9 10 25	109.90	110.24	−0.34	-----	------	15.49	------	------	−.09	+.11	
	14 10 7	166.35	166.86	−0.51	+5	11.13	10.97	+.16	+.20	−.10	.00	
	23 9 28	332.65	333.55	−0.90	+5	11.50	11.53	−.03	+.09	−.18	−.07	
	1907–08											
U. S. Naval Obs.: Hammond.	Dec. 27 10 37	270.51	271.38	−0.87	0	17.19	16.75	+.44	+.25	−.25	.00	A. J. XXVI, 29.
	31 12 54	19.30	21.39	−2.09	0	11.72	11.32	+.40	+.46	−.41	−.21	
	Jan. 3 12 18	197.64	198.13	−0.49	0	11.02	11.25	−.23	−.17	−.10	−.04	
	5 11 34	81.14	81.73	−0.59	−1	16.11	16.11	.00	−.10	−.17	+.08	
	10 11 39	117.32	118.49	−1.17	0	15.52	15.69	−.17	−.22	−.32	+.02	
	25 10 39	285.53	286.67	−1.14	0	16.82	16.60	+.22	+.05	−.33	+.01	
	Feb. 20 10 31	125.53	127.68	−2.15	0	14.38	14.43	−.05	−.05	−.54	−.22	
	24 10 40	259.86	260.92	−1.06	0	15.95	15.97	−.02	−.20	−.30	−.12	
	Mar. 3 10 12	114.60	115.98	−1.38	0	15.44	15.54	−.10	−.16	−.37	−.03	
	4 10 32	72.94	72.57	+0.37	0	15.28	15.12	+.16	+.08	+.10	+.31	
	9 12 35	105.47	106.19	−0.72	0	16.39	16.28	+.11	+.02	−.20	+.14	
	21 9 7	100.82	101.96	−1.14	−1	16.39	16.37	+.02	−.08	−.33	−.01	
	27 8 50	96.25	97.43	−1.18	−2	16.68	16.42	+.26	+.15	−.34	−.03	
	1907–08											
Yerkes: Barnard.	Oct. 1 18 20	170.39	171.42	−1.03	+7	10.93	11.06	−.13	−.14	−.20	+.04	A. N. Vol. 181, 321.
	13 18 16	150.18	151.68	−1.50	+6	12.22	12.23	−.01	−.06	−.32	−.06	
	Nov. 5 19 32	189.10	190.69	−1.59	+6	11.28	10.95	+.33	+.35	−.30	−.09	
	12 17 18	117.43	118.65	−1.22	+6	15.75	15.66	+.09	−.02	−.33	−.06	
	24 16 13	109.05	109.77	−0.72	+10	16.73	16.46	+.27	+.14	−.21	+.05	
	26 13 58	352.80	352.68	+0.12	+5	11.34	11.33	+.01	+.04	+.02	−.10	
	28 15 54	242.31	242.58	−0.27	+6	14.08	13.85	+.23	+.25	−.07	+.09	
	Dec. 1 18 11	52.46	52.64	−0.18	+8	13.20	12.92	+.28	+.11	−.04	−.06	
	3 14 37	286.63	284.82	+1.81	+6	16.50	16.74	−.24	−.20	+.53	+.65	
	5 16 47	327.55	148.54	−0.99	+6	12.58	12.74	−.16	−.21	−.22	+.05	Observed position angle, Dec. 5, assumed 180° wrong.
	12 17 25	92.31	92.51	−0.20	+6	16.92	16.74	+.18	+.02	−.06	+.14	
	25 13 58	28.76	28.22	+0.54	+5	11.74	11.52	+.22	+.12	+.11	+.01	
	Feb. 23 12 44	298.61	299.72	−1.11	+6	15.10	15.27	−.17	−.09	−.30	−.24	
	Mar. 3 12 45	110.83	111.18	−0.35	+6	16.26	16.00	+.26	+.14	−.10	+.16	
	8 10 38	172.30	172.82	−0.52	+6	11.18	11.14	+.04	+.04	−.10	+.14	
	10 9 57	67.36	67.53	−0.17	+5	14.72	14.52	+.20	+.02	−.04	+.02	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1908 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes:	Mar.29 9 46	141.25	321.56	−0.31	+ 4	12.76	12.77	− .01	+.08	−.07	−.11	Observed po-
Barnard.	Apr. 3 9 29	36.86	36.82	+0.04	+ 6	11.57	11.66	− .09	−.21	+.01	−.07	sition angle,
	4 9 16	315.37	315.02	+0.35	+ 5	13.16	13.34	− .18	−.08	+.08	+.07	Mar. 29, as-
	5 9 41	267.35	268.45	−1.10	+10	15.98	16.14	− .16	−.15	−.31	−.16	sumed 180°
	19 9 49	116.41	117.39	−0.98	+ 8	15.34	15.05	+ .29	+.18	−.26	.00	wrong.
	19 10 9	114.42	116.74	−2.32	+ 6	15.28	15.11	+ .17	+.06	−.61	−.35	
	21 9 24	4.73	4.39	+0.34	+ 6	10.54	10.69	− .15	−.16	+.06	−.07	
	May 3 9 53	341.02	340.56	+0.46	+ 5	11.21	11.27	− .06	.00	+.09	.00	
	10 9 40	278.20	279.32	−1.12	+ 8	15.82	16.03	− .21	−.18	−.31	−.19	
	1908–09											
Yerkes:	Sept.20 18 27	38.94	38.63	+0.31	+10	12.00	11.30	+ .70	+.48	+.06	−.02	A. N. Vol. 181,
Barnard.	Nov. 3 17 1	229.53	229.11	+0.42	+ 7	12.91	12.25	+ .66	+.66	+.09	+.17	323.
	3 17 20	229.07	228.14	+0.93	− 6	12.33	12.22	+ .11	+.11	+.20	+.28	
	17 13 43	90.88	93.11	−2.23	+10	16.99	16.50	+ .49	+.37	−.64	−.48	
	20 18 41	262.12	261.48	+0.64	+ 6	15.58	15.60	− .02	+.01	+.17	+.17	
	Dec. 1 14 30	301.56	300.50	+1.06	+ 6	15.61	15.67	− .06	+.03	+.29	+.09	
	13 13 28	292.03	291.48	+0.55	+ 5	16.45	16.47	− .02	+.07	+.16	+.01	
	20 15 46	233.64	234.02	−0.38	+ 5	12.80	12.99	− .19	−.19	−.09	−.02	
	24 13 31	333.36	332.34	+1.02	+ 7	12.52	12.53	− .01	−.01	+.22	−.07	
	27 12 47	149.49	150.11	−0.62	+ 4	12.64	12.68	− .04	−.12	−.14	.00	
	29 18 39	31.25	30.51	+0.74	+ 5	11.34	11.51	− .17	−.39	+.15	+.02	
	Jan. 12 14 13	264.45	264.54	−0.09	+ 6	15.69	16.23	− .54	−.50	−.03	−.05	
	19 12 9	195.01	196.50	−1.49	+ 6	11.18	11.15	+ .03	.00	−.29	−.17	
	24 11 49	258.00	257.82	+0.18	+ 6	15.37	15.60	− .23	−.20	+.05	+.06	
	26 14 7	113.60	113.20	+0.40	+ 5	16.10	16.24	− .14	−.23	+.11	+.28	
	31 14 44	163.87	164.58	−0.71	+ 7	11.91	11.66	+ .25	+.18	−.14	.00	
	Feb. 16 11 22	280.43	279.88	+0.55	+ 5	16.63	16.73	− .10	−.02	+.16	+.07	
	21 12 50	138.53	318.83	−0.30	+ 5	13.33	13.42	− .09	−.03	−.07	−.34	Observed po-
	26 10 21	41.05	40.61	+0.44	+ 5	12.15	12.00	+ .15	−.08	+.09	+.02	sition angle,
	28 11 36	269.43	269.39	+0.04	+ 7	16.36	16.44	− .08	−.03	+.01	−.03	Feb. 21, as-
	Mar. 2 10 34	133.37	133.38	−0.01	+ 5	14.09	13.89	+ .20	+.11	.00	+.16	sumed 180°
	14 10 24	120.25	120.72	−0.47	+10	15.53	15.15	+ .38	+.29	−.12	+.04	wrong.
	16 9 27	13.51	11.91	+1.60	+ 7	11.06	10.90	+ .16	−.01	+.30	+.09	
	21 9 22	73.67	74.32	−0.65	+ 7	15.22	15.01	+ .21	+.04	−.17	−.06	
	23 11 49	289.42	289.69	−0.27	+ 7	15.92	16.04	− .12	−.02	−.08	−.23	
	28 12 4	341.76	340.09	+1.67	+ 8	11.62	11.55	+ .07	+.03	+.34	+.06	
	Apr. 11 9 17	229.29	229.56	−0.27	+ 8	12.02	12.43	− .41	−.41	−.06	+.02	
	1908–09											
U. S. Naval Obs.:	Dec. 2 14 19	257.06	258.39	−1.33	0	15.97	15.41	+ .56	+.31	−.36	−.15	A. J. XXVI,
A. Hall, jr.	7 14 8	295.28	295.62	−0.34	0	16.00	16.13	− .13	−.35	−.10	+.02	179.
	13 12 42	292.27	292.83	−0.56	0	16.55	16.36	+ .19	−.04	−.16	−.03	
	26 12 52	234.20	233.88	+0.32	0	13.44	13.04	+ .40	+.16	+.07	+.27	
	31 14 40	272.42	274.21	−1.79	0	17.00	16.80	+ .20	−.05	−.52	−.33	
	Jan. 1 14 32	218.28	219.72	−1.44	0	11.95	12.00	− .05	−.28	−.30	−.11	
	17 11 42	307.03	306.70	+0.33	0	15.98	14.93	+1.05	+.85	+.09	+.17	
	18 9 44	267.77	267.22	+0.55	0	17.02	16.46	+ .56	+.31	+.16	+.36	
	20 15 4	116.34	116.95	−0.61	0	16.30	15.94	+ .36	+.04	−.17	−.02	
	Feb. 10 10 17	285.99	286.78	−0.79	0	------	16.57	------	------	−.23	−.08	
	11 12 21	*234.58	236.41	−1.83	0	12.99	13.35	− .36	−.60	−.43	−.23	
	13 14 34	96.16	97.01	−0.85	0	17.41	16.79	+ .62	+.28	−.25	−.10	
	17 11 29	229.22	230.64	−1.42	0	12.89	12.81	+ .08	−.15	−.32	−.12	
	17 14 0	222.81	223.05	−0.24	0	11.98	12.22	− .24	−.47	−.05	+.14	
	20 12 24	44.74	43.46	+1.28	0	12.77	12.24	+ .53	+.23	+.27	+.29	
	25 12 11	90.82	91.24	−0.42	0	17.42	16.56	+ .86	+.51	−.12	+.02	
	26 12 2	35.40	35.00	+0.40	0	12.12	11.69	+ .43	+.15	+.08	+.08	
	Mar. 5 11 29	307.01	307.81	−0.80	0	------	14.44	------	------	−.20	−.13	
	11 10 50	301.98	302.86	−0.88	0	14.67	14.92	− .25	−.44	−.23	−.14	
	15 9 16	79.76	80.28	−0.52	0	15.39	15.66	− .27	−.62	−.14	−.02	
	17 9 1	299.58	300.51	−0.93	0	15.56	15.11	+ .45	+.25	−.25	−.15	
	20 8 51	117.55	117.92	−0.37	0	15.17	15.35	− .18	−.48	−.10	+.04	
	21 11 0	70.36	70.93	−0.57	0	14.89	14.67	+ .22	−.12	−.15	−.06	
	21 12 21	67.48	68.01	−0.53	0	15.09	14.36	+ .73	+.39	−.13	−.05	
	22 9 9	1.98	1.62	+0.36	0	11.66	10.88	+ .78	+.58	+.07	+.04	
	23 10 42	291.21	291.69	−0.48	0	16.21	15.89	+ .32	+.10	−.13	.00	
	26 8 36	113.65	112.83	+0.82	0	15.52	15.76	− .24	−.55	+.22	+.36	
	1909–10											
Yerkes:	Sept.24 18 17	104.72	105.30	−0.58	+ 6	16.64	16.20	+ .44	+.29	−.16	−.08	A. J. XXVI,
Barnard.	28 17 35	234.20	234.26	−0.06	+ 6	11.94	12.18	− .24	.00	−.01	+.15	144.
	Oct. 26 16 52	301.99	301.33	+0.66	+ 4	15.55	15.60	− .05	−.01	+.18	.00	
	Nov.14 16 14	239.43	239.10	+0.33	+ 5	12.62	12.92	− .30	−.05	+.07	+.20	
	30 15 20	318.40	317.62	+0.78	+11	14.39	14.11	+ .28	+.30	+.19	+.02	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks.
		O	C	O-C		O	C	O-C	v	O-C	v	
	1909-10 h m	°	°	°	m	"	"	"	"	"	"	
Yerkes: Barnard.	Dec. 7 13 21	272.78	271.56	+1.22	+ 5	16.18	16.38	- .20	-.04	+.35	+.25	
	19 13 5	261.90	260.97	+0.93	+ 6	14.74	15.49	- .75	-.55	+.25	+.22	
	28 13 34	69.49	70.46	-0.97	+ 6	14.84	14.41	+ .43	+.38	-.24	-.28	
	Jan. 6 13 23	240.29	239.91	+0.38	+ 7	12.95	13.35	- .40	-.15	+.09	+.22	
	8 13 10	104.47	104.69	-0.22	+ 7	17.07	16.90	+ .17	+.01	-.06	+.02	
	9 14 57	51.34	51.29	+0.05	+ 5	12.52	12.61	- .09	-.13	+.01	-.05	
	Feb. 1 12 4	85.01	86.01	-1.00	+ 8	16.24	16.13	+ .11	+.02	-.28	-.28	
	6 12 20	121.42	122.37	-0.95	+ 6	15.76	15.57	+ .19	-.04	-.26	-.06	
	8 14 33	1.28	359.76	+1.52	+11	11.34	11.18	+ .16	+.14	+.30	+.17	
	12 11 32	117.62	118.20	-0.58	+ 6	16.22	15.93	+ .29	+.07	-.16	+.01	
	27 11 50	285.06	284.56	+0.50	+ 4	16.50	16.66	- .16	-.07	+.15	-.01	
	Mar. 1 8 38	161.54	163.89	-2.35	+ 7	11.36	11.69	- .33	-.43	-.48	-.08	
	5 13 27	275.02	276.84	-1.82	+10	16.06	16.62	- .56	-.44	-.53	-.66	
	8 10 42	98.79	98.97	-0.18	+ 5	16.70	16.63	+ .07	-.07	-.05	.00	
	12 11 56	217.36	218.93	-1.57	+ 5	12.00	11.69	+ .31	+.53	-.32	-.05	
	13 12 8	135.82	136.42	-0.60	+ 6	14.24	13.77	+ .47	+.24	-.14	+.15	
	15 8 57	44.60	43.90	+0.70	+ 5	12.00	11.97	+ .03	-.01	+.15	+.07	
	22 10 9	310.23	310.69	-0.46	+ 5	14.32	14.30	+ .02	+.04	-.11	-.29	
	Apr. 2 12 0	0.51	359.99	+0.52	+11	10.72	10.89	- .17	-.19	+.10	-.02	
	12 9 25	113.14	111.80	+1.34	+ 6	16.36	15.92	+ .44	+.24	+.37	+.49	
	1909-10											
U. S. Naval Obs. A. Hall, jr.	Dec. 9 13 40	130.77	131.34	-0.57	0	14.57	14.78	- .21	-.19	-.15	-.55	A. J. XXVI, 180.
	10 12 12	92.42	90.97	+1.45	------	------	16.37	------	------	+.41	+.26	
	16 12 53	87.77	84.25	+3.52	0	15.47	15.83	- .36	-.32	+.97	+.87	
	17 13 34	12.59	12.56	+0.03	0	11.51	11.06	+ .45	+.35	+.01	+.15	
	Jan. 7 13 52	156.39	154.76	+1.63	------	------	12.48	------	------	+.36	-.06	
	8 10 31	111.94	109.17	+2.77	0	16.39	16.75	- .36	-.30	+.81	+.51	
	8 12 14	107.71	106.26	+1.45	0	16.25	16.86	- .61	-.55	+.43	+.15	
	10 11 26	336.62	337.79	-1.17	0	12.17	12.26	- .09	-.27	-.25	-.13	
	10 14 13	328.07	329.36	-1.29	0	13.28	12.92	+ .36	+.17	-.29	-.19	
	19 13 41	139.26	138.97	+0.29	0	13.65	13.88	- .23	-.24	+.07	-.35	
	29 9 37	272.48	272.98	-0.50	0	16.91	16.65	+ .26	+.10	-.15	-.08	
	29 10 40	271.32	271.16	+0.16	0	16.98	16.54	+ .44	+.28	+.05	+.12	
	29 12 33	266.58	267.83	-1.25	0	16.70	16.30	+ .40	+.23	-.36	-.29	
	Feb. 1 13 3	83.31	84.19	-0.88	0	15.84	15.98	- .14	-.10	-.25	-.35	
	1 14 48	79.81	80.86	-1.05	0	16.16	15.66	+ .50	+.54	-.29	-.37	
	7 10 23	84.14	83.61	+0.53	0	15.65	15.92	- .27	-.23	+.15	+.05	
	7 12 39	79.13	79.23	-0.10	0	16.08	15.48	+ .60	+.64	-.03	-.10	
	10 12 54	255.00	255.71	-0.71	0	14.96	15.10	- .14	-.35	-.19	-.14	
	13 11 14	77.05	76.09	+0.96	0	15.36	15.14	+ .22	+.26	+.25	+.20	
	18 11 55	112.91	112.11	+0.80	0	16.15	16.36	- .21	-.15	+.23	-.09	
	22 12 32	243.09	243.05	+0.04	0	13.64	13.72	- .08	-.33	+.01	+.02	
	25 10 18	65.02	64.92	+0.10	0	13.99	13.90	+ .09	+.11	+.02	+.04	
	25 13 10	57.27	57.57	-0.30	0	13.47	13.17	+ .30	+.31	-.07	-.02	
	Mar. 3 11 24	52.16	54.28	-2.12	------	------	12.85	------	------	-.47	-.40	
	4 10 58	331.44	331.59	-0.15	0	12.53	12.43	+ .10	-.08	-.03	+.08	
	8 10 11	100.57	99.83	+0.74	0	16.47	16.64	- .17	-.11	+.21	-.02	
	8 10 55	99.42	98.60	+0.82	------	------	16.63	------	------	+.24	+.02	
	14 9 47	98.16	95.53	+2.63	0	16.41	16.51	- .10	-.04	+.76	+.57	
	15 10 5	39.77	40.21	-0.44	0	11.96	11.76	+ .20	+.17	-.09	+.02	
	17 11 9	271.87	270.64	+1.23	------	------	16.26	------	------	+.35	+.42	
	26 9 19	85.69	86.00	-0.31	0	16.07	15.85	+ .22	+.27	-.09	-.21	
	Apr. 2 10 2	7.08	7.57	-0.49	0	11.04	10.80	+ .24	+.13	-.09	+.06	
	8 9 22	356.95	358.75	-1.80	0	11.14	10.87	+ .27	+.14	-.34	-.20	
	9 9 10	295.25	294.88	+0.37	0	15.72	15.70	+ .02	-.14	+.10	+.17	
	9 9 52	------	293.62	------	0	15.86	15.80	+ .06	-.10	------	------	
	13 9 28	67.14	67.73	-0.59	0	13.87	13.87	.00	+.02	-.14	-.14	
	14 9 36	343.80	346.99	-3.19	0	11.40	11.23	+ .17	+.01	-.63	-.50	
	1910-11											
Yerkes: Barnard.	Sept. 27 18 25	254.33	254.68	-0.35	+ 3	13.56	13.84	- .28	-.19	-.08	-.10	A. J. XXVII, 111.
	Oct. 2 17 37	295.60	294.45	+1.15	+ 7	16.09	16.05	+ .04	-.09	+.32	-.01	
	7 17 52	343.03	341.31	+1.72	+ 5	12.36	11.82	+ .54	+.21	+.35	+.23	
	9 17 35	242.20	241.93	+0.27	+ 6	12.41	12.63	- .22	-.13	+.06	+.15	
	16 18 30	146.50	146.68	-0.18	+ 6	13.10	13.12	- .02	-.38	-.04	+.05	
	18 18 18	44.53	46.12	-1.59	+ 5	11.72	11.53	+ .19	+.07	-.32	-.16	
	25 17 25	320.48	318.49	+1.99	+18	14.57	14.08	+ .49	+.21	+.49	+.22	
	25 17 38	319.27	317.99	+1.28	+ 9	15.16	14.10	+1.06	+.78	+.31	+.03	
	30 17 32	28.76	27.51	+1.25	+ 6	11.00	10.87	+ .13	-.09	+.24	+.38	
	Nov. 1 16 1	272.19	272.12	+0.07	+ 5	15.83	15.88	- .05	-.02	+.02	-.18	
	11 16 47	6.66	7.47	-0.81	+ 5	11.23	10.92	+ .31	+.01	-.15	-.10	
	24 15 19	294.35	293.89	+0.46	+ 5	16.44	16.53	- .09	-.22	+.13	-.21	
	29 16 55	336.34	336.32	+0.02	+ 6	12.60	12.51	+ .09	-.25	.00	-.16	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1910–11 h m	°	°	°	m	"	"	"	"	"	"	
Yerkes: Barnard.	Dec. 11 13 32	330.84	329.18	+1.66	+ 5	14.23	13.18	+1.05	+.72	+.38	+.17	
	20 13 46	137.61	137.52	+0.09	+ 6	14.92	14.39	+ .53	+.16	+.02	+.06	
	Jan. 3 15 55	2.86	1.67	+1.19	+ 6	11.00	11.24	− .24	−.56	+.23	+.25	
	22 14 7	286.25	286.00	+0.25	+ 7	16.82	16.89	− .07	−.15	+.07	−.24	
	29 11 58	235.03	234.91	+0.12	+ 5	12.51	12.71	− .20	−.13	+.03	+.18	
	Feb. 7 13 14	34.56	36.42	−1.86	+ 6	11.40	11.52	− .12	−.30	−.37	−.21	
	21 11 20	265.21	264.85	+0.36	+ 4	15.58	15.73	− .15	−.09	+.10	−.04	
	Mar. 7 10 48	114.03	114.44	−0.41	+ 6	16.44	16.25	+ .19	−.07	−.12	−.16	
	12 10 14	165.54	167.05	−1.51	+ 6	11.80	11.57	+ .23	−.09	−.30	−.07	
	14 9 27	66.59	66.69	−0.10	+ 7	14.18	13.69	+ .49	+.44	−.02	+.10	
	19 10 36	104.63	104.64	−0.01	+ 6	16.72	16.55	+ .17	−.01	.00	−.04	
	Apr. 16 12 10	182.08	182.90	−0.82	+ 5	11.12	10.80	+ .32	+.10	−.15	+.13	
	1911											
U. S. Naval Obs.: A. Hall, jr.	Jan. 28 11 18	286.34	285.71	+0.63	+23	16.78	16.88	− .10	−.14	+.19	+.22	A. J. XXVIII, 42.
	Feb. 2 13 0	322.93	323.93	−1.00	+ 7	13.51	13.58	− .07	−.25	−.24	−.24	
	21 13 10	261.07	261.28	−0.21	+15	15.11	15.33	− .22	−.17	−.06	+.10	
	23 8 58	128.98	129.25	−0.27	----	------	14.96	------	------	−.07	−.14	
	23 12 25	122.55	122.35	+0.20	+17	16.08	15.73	+ .35	+.12	+.05	−.05	
	24 11 11	82.92	82.27	+0.65	+19	15.66	15.42	+ .24	+.19	+.18	+.12	
	Mar. 1 10 45	120.50	119.89	+0.61	+17	16.19	15.91	+ .28	+.06	+.17	+.06	
	3 11 1	359.60	0.23	−0.63	+16	11.22	11.13	+ .09	−.05	−.12	−.05	
	4 12 15	295.10	294.50	+0.60	+15	16.35	16.30	+ .05	−.05	+.17	+.17	
	8 11 0	69.34	70.04	−0.70	----	------	14.11	------	------	−.17	−.19	
	10 10 21	291.85	292.64	−0.79	+19	16.36	16.36	.00	−.09	−.23	−.23	
	16 9 49	288.42	288.46	−0.04	+21	16.48	16.50	− .02	−.08	−.01	+.01	
	21 9 35	333.57	334.76	−1.19	+19	12.47	12.34	+ .13	−.05	−.25	−.23	
	24 10 10	150.77	148.72	+2.05	+22	13.35	12.83	+ .52	+.22	+.46	+.50	
	25 11 13	99.62	98.63	+0.99	+21	16.69	16.42	+ .27	+.16	+.28	+.17	
	28 9 14	279.84	279.48	+0.36	+19	16.45	16.43	+ .02	.00	+.10	+.15	
	30 11 4	139.10	138.63	+0.47	----	------	13.66	------	------	+.11	+.09	
	31 9 13	96.17	97.01	−0.84	+22	16.46	16.31	+ .15	+.05	−.24	−.35	
	31 10 50	94.15	94.24	−0.09	+27	16.29	16.16	+ .13	+.04	−.03	−.13	
	1911											
U. S. Naval Obs.: Burton.	Jan. 30 11 51	147.76	151.09	−3.33	----	------	12.90	------	------	−.75	−.75	A. J. XXVIII, 43.
	Feb. 2 14 50	318.88	319.34	−0.46	+ 4	14.03	14.04	− .01	−.16	−.11	+.21	
	21 11 26	264.60	264.66	−0.06	+50	15.47	15.58	− .11	−.07	−.02	+.07	
	23 11 34	125.37	123.98	+1.39	+30	16.05	15.61	+ .44	+.32	+.38	+.21	
	24 12 42	79.65	79.24	+0.41	+27	14.81	15.07	− .26	−.12	+.11	−.11	
	27 11 2	259.13	259.61	−0.48	+36	15.10	15.07	+ .03	+.10	−.13	−.04	
	Mar. 1 12 1	117.80	117.57	+0.23	+23	16.24	16.12	+ .12	+.02	+.06	−.15	
	2 10 18	77.76	78.07	−0.31	+29	14.87	14.91	− .04	+.10	−.08	−.30	
	4 10 54	295.85	296.90	−1.05	+23	16.12	16.14	− .02	−.18	−.30	−.10	
	8 11 46	69.81	68.24	+1.57	+27	13.20	13.81	− .61	−.41	+.38	+.23	
	10 11 49	290.00	290.12	−0.12	+22	16.52	16.49	+ .03	−.10	−.03	+.13	
	11 10 6	247.94	248.68	−0.74	+19	13.93	13.87	+ .06	+.15	−.18	−.07	
	16 11 24	285.46	285.79	−0.33	+23	16.75	16.56	+ .19	+.09	−.10	+.04	
	20 10 34	56.31	55.89	+0.42	+39	12.01	12.52	− .51	−.27	+.09	+.03	
	21 10 59	329.16	330.61	−1.45	+20	12.68	12.68	.00	−.08	−.32	+.02	
	23 9 44	234.18	234.04	+0.14	+24	12.70	12.40	+ .30	+.39	+.03	+.16	
	24 11 45	146.30	144.38	+1.92	+19	13.34	13.22	+ .12	−.01	+.44	+.40	
	25 9 35	102.59	101.38	+1.21	+24	16.59	16.49	+ .10	+.08	+.35	+.08	
	28 10 59	275.42	276.52	−1.10	+23	16.44	16.31	+ .13	+.09	−.31	−.20	
	30 9 57	142.24	141.40	+0.84	+21	13.61	13.46	+ .15	+.02	+.20	+.14	
	1911–12											
Yerkes: Barnard.	Dec. 19 12 41	162.38	163.74	−1.36	+ 5	12.06	12.15	− .09	−.19	−.29	−.11	A. J. XXVII, 111.
	Jan. 12 12 44	132.74	133.09	−0.35	+ 6	15.40	15.10	+ .30	+.15	−.09	+.05	
	14 13 18	22.09	21.34	+0.75	+ 8	11.18	11.04	+ .14	+.06	+.14	+.07	
	19 13 3	83.28	84.23	−0.95	+ 9	15.80	15.38	+ .42	+.30	−.26	−.23	
	21 17 17	296.55	296.20	+0.35	+ 5	16.74	16.62	+ .12	+.10	+.10	+.06	
	30 13 54	114.29	114.30	−0.01	+ 5	16.95	16.69	+ .26	+.11	.00	+.10	
	Feb. 3 12 8	250.65	249.83	+0.82	+ 7	13.43	13.83	− .40	−.37	+.20	+.26	
	19 13 6	323.23	323.15	+0.08	+ 5	13.55	13.79	− .24	−.26	+.02	−.06	
	Mar. 4 10 18	207.89	209.38	−1.49	+ 5	11.35	11.09	+ .26	+.27	−.29	−.14	
	9 10 55	266.61	265.90	+0.71	+ 5	15.33	15.49	− .16	−.15	+.19	+.21	
	16 11 45	182.02	181.10	+0.92	+ 6	11.17	11.07	+ .10	+.05	+.18	+.36	
	18 11 39	75.47	75.18	+0.29	+ 5	14.39	14.30	+ .09	−.03	+.07	+.08	
	Apr. 8 11 16	226.40	228.21	−1.81	+ 5	11.90	11.73	+ .17	+.20	−.37	−.26	
	21 11 20	130.07	131.18	−1.11	+ 3	14.68	14.57	+ .11	−.03	−.28	−.15	
	22 10 17	90.70	90.51	+0.19	+ 4	15.53	15.55	− .02	−.14	+.05	+.09	
	27 10 19	126.63	127.26	−0.63	+ 6	14.98	14.94	+ .04	−.10	−.16	−.04	
	May 5 10 25	0.73	1.67	−0.94	+ 4	10.75	10.75	.00	−.05	−.18	−.26	
	7 10 19	255.06	255.70	−0.64	+ 4	14.00	13.92	+ .08	+.10	−.16	−.12	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O–C		O	C	O–C	v	O–C	v	
	1911–12 h m	°	°	°	m	″	″	″	″	″	″	
U. S. Naval Obs.: Burton.	Dec. 18 13 42	244.87	244.84	+0.03	0	13.20	13.16	+.04	+.02	+.01	+.20	A. J. XXVIII, 45.
	19 14 15	158.90	158.87	+0.03	0	12.54	12.50	+.04	−.13	+.01	+.07	
	Jan. 10 12 48	272.11	273.19	−1.08	0	16.26	16.26	.00	−.01	−.31	−.16	
	10 14 22	268.90	270.32	−1.42	0	15.98	16.00	−.02	−.03	−.40	−.24	
	13 11 25	92.65	92.99	−0.34	0	16.37	16.25	+.12	−.01	−.10	−.20	
	19 11 27	88.40	87.37	+1.03	0	15.89	15.74	+.15	+.02	+.28	+.18	
	19 12 56	85.28	84.47	+0.81	0	15.52	15.44	+.08	−.04	+.22	+.12	
	20 12 15	14.27	14.02	+0.25	0	11.08	11.04	+.04	+.03	+.05	−.01	
	20 14 7	6.43	6.78	−0.35	0	11.16	11.13	+.03	+.02	−.07	−.12	
	21 12 0	305.85	305.71	+0.14	0	15.96	15.83	+.13	+.09	+.04	+.12	
	22 11 14	265.39	264.89	+0.50	0	15.40	15.49	−.09	−.10	+.14	+.31	
	22 12 22	261.41	262.61	−1.20	0	15.12	15.25	−.13	−.13	−.32	−.15	
	24 11 42	123.28	123.48	−0.20	0	15.98	16.03	−.05	−.20	−.06	−.10	
	24 13 19	120.92	120.53	+0.39	0	16.55	16.29	+.26	+.11	+.11	+.06	
	27 13 39	297.08	297.30	−0.22	0	16.77	16.52	+.25	+.21	−.06	+.04	
	Feb. 2 12 46	293.28	293.68	−0.40	0	16.75	16.69	+.06	+.02	−.12	−.01	
	5 12 23	112.01	111.80	+0.21	0	16.83	16.75	+.08	−.06	+.06	−.01	
	6 10 57	69.44	69.09	+0.35	0	13.83	13.78	+.05	−.05	+.08	−.03	
	6 13 10	63.89	63.32	+0.57	0	13.18	13.21	−.03	−.12	+.13	+.02	
	8 12 20	289.05	289.37	−0.32	0	16.90	16.81	+.09	+.06	−.09	+.02	
	9 12 47	238.84	240.31	−1.47	0	13.18	12.93	+.25	+.23	−.33	−.14	
	13 12 0	333.44	333.99	−0.55	0	12.68	12.77	−.09	−.10	−.12	−.11	
	13 13 25	329.37	330.02	−0.65	0	13.06	13.12	−.06	−.08	−.15	−.13	
	14 10 34	287.21	287.33	−0.12	0	16.81	16.81	.00	−.03	−.04	+.08	
	14 12 10	284.41	284.66	−0.25	0	16.56	16.80	−.24	−.27	−.07	+.06	
	17 10 18	105.54	105.30	+0.24	0	16.96	16.79	+.17	+.03	+.07	−.01	
	17 11 36	103.63	103.12	+0.51	0	16.94	16.76	+.18	+.04	+.15	+.07	
	23 9 10	102.29	102.18	+0.11	0	16.94	16.71	+.23	+.09	+.03	−.05	
	23 12 1	97.61	97.34	+0.27	0	16.66	16.51	+.15	+.01	+.08	−.01	
	27 12 15	213.21	213.08	+0.13	0	11.20	11.23	−.03	−.11	+.03	+.21	
	28 11 49	135.43	135.75	−0.32	0	14.50	14.49	+.01	−.15	−.08	−.09	
	Mar. 2 11 20	313.03	313.56	−0.53	0	14.74	14.71	+.03	.00	−.14	−.08	
	7 11 21	19.90	19.68	+0.22	0	10.77	10.92	−.15	−.17	+.04	−.03	
	10 11 34	192.47	193.12	−0.65	0	11.22	10.90	+.32	+.20	−.12	+.02	
	13 10 49	10.58	10.31	+0.27	0	10.90	10.90	.00	−.01	+.05	−.01	
	16 11 22	181.61	182.55	−0.94	0	11.15	11.02	+.13	−.01	−.18	−.06	
	17 11 15	119.16	119.27	−0.11	0	16.16	16.00	+.16	+.02	−.03	−.08	
	18 11 4	76.74	76.49	+0.25	0	14.48	14.46	+.02	−.09	+.06	−.04	
	29 10 28	110.52	110.33	+0.19	0	16.52	16.40	+.12	−.02	+.05	−.02	
	31 9 23	343.85	343.38	+0.47	0	11.88	11.76	+.12	+.11	+.10	+.10	
	Apr. 6 9 50	333.52	332.91	+0.61	0	12.40	12.49	−.09	−.10	+.13	+.15	
	9 9 11	150.16	150.57	−0.41	0	13.22	12.68	+.54	+.38	−.09	−.06	
	10 10 7	101.67	101.03	+0.64	0	16.48	16.30	+.18	+.05	+.18	+.10	
	11 9 39	49.54	48.64	+0.90	0	12.20	11.76	+.44	+.38	+.18	+.08	
	1912–13											
Yerkes: Barnard.	Oct. 12 18 35	273.41	272.96	+0.45	+4	15.12	15.25	−.13	−.02	+.12	+.05	A. J. XXVIII, 10.
	15 18 37	90.11	90.07	+0.04	+4	15.17	14.98	+.19	+.14	+.01	+.02	
	29 18 5	300.64	299.62	+1.02	+5	15.83	16.24	−.41	−.35	+.29	+.10	
	Nov. 9 16 4	344.22	344.19	+0.03	+4	12.72	12.06	+.66	+.62	+.01	−.19	
	10 16 2	294.21	293.16	+1.05	+8	16.47	16.55	−.08	.00	+.30	+.13	
	16 14 23	291.88	290.99	+0.89	+5	16.62	16.62	.00	+.08	+.26	+.10	
	17 16 18	235.09	235.05	+0.04	+4	11.58	11.84	−.26	−.16	+.01	+.13	
	Dec. 8 15 34	20.63	19.73	+0.90	+5	10.88	10.86	+.02	−.08	+.17	+.04	
	21 13 26	303.38	302.93	+0.45	+5	16.32	16.34	−.02	+.04	+.13	−.08	
	22 13 40	260.30	259.30	+1.00	+5	14.00	14.36	−.36	−.23	+.25	+.26	
	28 15 16	246.99	248.04	−1.05	+6	12.93	13.21	−.28	−.16	−.24	−.17	
	Jan. 3 17 2	233.50	234.14	−0.64	+7	12.10	12.07	+.03	+.13	−.14	−.01	
	4 13 37	158.80	159.73	−0.93	+6	12.29	12.62	−.33	−.47	−.20	−.04	
	18 14 25	37.57	37.74	−0.17	+5	11.26	11.29	−.03	−.14	−.03	−.11	
	26 12 57	273.62	273.19	+0.43	+8	15.31	16.04	−.73	−.61	+.12	+.04	
	28 12 3	133.43	134.43	−1.00	+5	15.26	15.14	+.12	−.03	−.26	−.17	
	Feb. 1 12 57	267.99	267.54	+0.45	+5	15.35	15.48	−.13	−.01	+.12	+.08	
	4 10 27	88.99	89.51	−0.52	+5	15.93	15.68	+.25	+.19	−.14	−.13	
	9 12 45	121.28	121.78	−0.50	+6	16.24	16.31	−.07	−.19	−.14	−.09	
	11 11 8	5.58	5.22	+0.36	+6	11.36	11.15	+.21	+.12	+.07	−.09	
	23 14 31	334.56	334.32	+0.24	+7	12.73	12.90	−.17	−.19	+.05	−.17	
	Mar. 4 10 34	151.61	153.01	−1.40	+5	13.15	12.95	+.20	+.06	−.32	−.17	
	9 12 45	220.08	220.38	−0.30	+6	11.61	11.33	+.28	+.35	−.06	+.11	
	11 12 0	97.64	97.80	−0.16	+5	16.47	16.29	+.18	+.12	−.05	−.03	
	15 13 1	208.78	208.40	+0.38	+6	11.47	10.93	+.54	+.57	+.07	+.27	
	16 11 28	136.35	136.34	+0.01	+6	14.89	14.57	+.32	+.17	.00	+.10	
	29 11 14	84.05	82.50	+1.55	+5	14.92	14.73	+.19	+.13	+.40	+.40	
	30 12 11	4.70	3.09	+1.61	+5	11.00	10.97	+.03	−.05	+.31	+.14	
	Apr. 6 11 22	296.44	296.85	−0.41	+9	16.04	16.18	−.14	−.07	−.12	−.31	
	13 11 13	244.45	245.04	−0.59	+7	12.84	12.79	+.05	+.17	−.13	−.05	
	14 9 12	165.86	167.38	−1.52	+7	11.85	11.58	+.27	+.15	−.31	−.13	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		s sin dp		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1912–13 h m	°	°	°	m	"	"	"	"	"	"	
U. S. Naval Obs.: A. Hall, jr.	Dec. 9 14 37	311.29	311.70	−0.41	0	16.05	15.48	+.57	+.27	−.11	+.14	A. J. XXXII, 113.
	13 14 10	88.63	87.72	+0.91	+ 1	15.19	15.26	−.07	−.04	+.24	.00	
	19 14 31	82.78	80.72	+2.06	− 2	14.54	14.53	+.01	+.08	+.52	+.32	
	28 13 12	254.57	253.38	+1.19	+ 1	13.85	13.78	+.07	+.03	+.29	+.39	
	28 15 49	245.86	246.55	−0.69	0	13.08	13.09	−.01	−.05	−.16	−.06	
	30 13 43	116.20	114.80	+1.40	+ 1	16.72	16.81	−.09	−.24	+.41	+.11	
	Jan. 1 12 10	348.71	348.92	−0.21	− 4	12.16	11.91	+.25	+.14	−.04	+.32	
	8 13 38	286.96	287.51	−0.55	+ 1	17.14	16.87	+.27	+.06	−.16	−.03	
	9 14 54	229.72	231.50	−1.78	+ 6	11.51	11.94	−.43	−.48	−.37	−.26	
	14 15 9	279.26	279.90	−0.64	+ 4	16.74	16.56	+.18	+.02	−.18	−.07	
	14 16 18	276.35	277.90	−1.55	+ 2	16.48	16.43	+.05	−.09	−.44	−.34	
	Feb. 4 12 44	86.06	84.99	+1.07	+ 9	15.03	15.19	−.16	−.12	+.28	+.05	
	6 12 33	303.78	304.83	−1.05	0	16.48	16.06	+.42	+.12	−.29	−.07	
	7 11 14	264.60	265.02	−0.42	+ 2	15.50	15.22	+.28	+.20	−.11	−.02	
	12 12 34	298.94	299.48	−0.54	+ 1	16.68	16.45	+.23	−.05	−.15	+.04	
	13 9 56	261.60	261.53	+0.07	0	14.90	14.84	+.06	−.01	+.02	+.11	
	15 12 17	117.10	117.41	−0.31	− 9	16.36	16.55	−.19	−.35	−.09	−.37	
	18 11 43	295.24	295.82	−0.58	+ 1	17.14	16.62	+.52	+.25	−.17	.00	
	25 11 26	242.29	243.44	−1.15	0	13.23	12.93	+.30	+.25	−.26	−.16	
	1913											
U. S. Naval Obs.: Burton.	Feb. 28 9 16	65.88	65.32	+0.56	+ 2	13.18	13.09	+.09	+.04	+.13	+.16	A. J. XXXII, 114.
	28 11 17	60.50	59.63	+0.87	+ 1	12.44	12.59	−.15	−.21	+.19	+.22	
	Mar. 5 12 14	102.08	102.48	−0.40	+ 2	16.30	16.58	−.28	−.28	−.12	−.14	
	6 11 20	50.66	50.33	+0.33	+ 1	11.85	11.88	−.03	−.10	+.07	+.09	
	7 9 24	332.60	332.17	+0.43	+ 2	13.17	12.99	+.18	+.12	+.10	+.05	
	8 9 0	285.48	285.42	+0.06	0	16.74	16.65	+.09	+.05	+.02	.00	
	18 11 28	28.62	28.69	−0.07	0	10.94	10.93	+.01	−.07	−.01	−.01	
	20 9 12	275.21	274.89	+0.32	+ 2	16.18	16.02	+.16	+.10	+.09	+.07	
	20 10 23	272.60	272.76	−0.16	+ 1	16.00	15.85	+.15	+.09	−.04	−.06	
	22 10 59	131.78	131.16	+0.62	0	15.12	15.07	+.05	+.07	+.16	+.06	
	24 10 41	22.29	20.28	+2.01	+ 1	10.80	10.79	+.01	−.07	+.38	+.37	
	28 9 5	129.46	129.06	+0.40	+ 1	15.34	15.23	+.11	+.13	+.11	+.02	
	28 11 24	124.61	124.66	−0.05	0	15.78	15.66	+.12	+.14	−.01	−.09	
	29 9 17	86.08	86.44	−0.36	+ 1	15.12	15.17	−.05	−.07	−.10	−.08	
	29 10 15	83.84	84.51	−0.67	+ 1	14.66	14.97	−.31	−.33	−.17	−.15	
	31 9 23	306.17	305.67	+0.50	+ 1	15.58	15.54	+.04	.00	+.14	+.09	
	31 10 30	304.00	303.60	+0.40	0	16.12	15.72	+.40	+.37	+.11	+.07	
	Apr. 1 9 48	262.32	262.41	−0.09	− 1	14.96	14.72	+.24	+.16	−.02	−.04	
	1 10 53	259.18	260.11	−0.93	+ 1	14.40	14.47	−.07	−.15	−.23	−.25	
	5 9 8	4.56	3.45	+1.11	+ 1	11.12	10.92	+.20	+.12	+.21	+.18	
	7 9 1	257.40	257.72	−0.32	+ 1	14.30	14.16	+.14	+.05	−.08	−.10	
	17 10 47	338.01	337.72	+0.29	− 1	12.40	12.21	+.19	+.13	+.06	+.01	
	19 9 46	240.90	240.83	+0.07	0	12.70	12.40	+.30	+.20	+.02	−.02	
	21 9 38	107.10	107.37	−0.27	+ 1	16.12	16.28	−.16	−.15	−.08	−.11	
	22 9 28	57.56	57.37	+0.19	0	12.10	12.09	+.01	−.05	+.04	+.07	
	24 9 6	285.72	285.82	−0.10	+ 1	16.52	16.24	+.28	+.24	−.03	−.05	
	May 1 9 30	222.68	222.68	0.00	+ 1	11.00	11.12	−.12	−.23	.00	−.07	
	3 9 18	98.01	98.00	+0.01	+ 1	15.68	15.83	−.15	−.15	.00	−.01	
	8 9 31	135.08	134.94	+0.14	− 1	14.10	14.31	−.21	−.20	+.04	−.06	
	1913–14											
Yerkes: Barnard.	Oct. 26 16 9	99.90	100.51	−0.61	+ 6	16.17	15.79	+.38	+.24	−.17	−.13	A. J. XXIX, 39.
	Nov. 11 17 38	180.12	182.25	−2.13	+ 8	11.05	11.08	−.03	−.14	−.41	−.04	
	15 16 20	303.91	302.96	+0.95	+ 5	16.10	16.30	−.20	−.25	+.27	+.05	
	22 15 29	254.79	253.88	+0.91	+ 8	13.22	13.18	+.04	+.20	+.21	+.25	
	22 15 47	253.84	253.10	+0.74	+ 8	13.25	13.10	+.15	+.31	+.17	+.22	
	23 16 7	164.77	167.31	−2.54	+ 5	12.01	12.02	−.01	−.21	−.53	−.18	
	Dec. 7 14 58	52.94	53.38	−0.44	+10	12.09	11.61	+.48	+.39	−.09	−.10	
	16 13 58	218.43	221.21	−2.78	+ 5	10.73	11.11	−.38	−.26	−.54	−.27	
	Jan. 24 14 11	333.99	333.13	+0.86	+ 9	13.90	13.37	+.53	+.42	+.20	+.03	
	29 15 37	42.80	42.56	+0.24	+ 8	11.28	11.31	−.03	−.14	+.05	+.03	
	31 14 13	281.53	281.85	−0.32	+ 6	16.40	16.53	−.13	−.09	−.09	−.25	
	Feb. 3 13 10	102.27	101.09	+1.18	+ 5	16.37	16.47	−.10	−.27	+.34	+.38	
	24 13 5	261.18	261.11	+0.07	+ 6	14.32	14.45	−.13	+.01	+.02	.00	
	26 12 44	121.54	122.05	−0.51	+ 6	16.75	16.35	+.40	+.12	−.15	−.02	
	26 13 6	121.48	121.42	+0.06	+ 5	16.48	16.40	+.08	−.20	+.02	+.15	
	Mar. 1 12 56	299.76	299.16	+0.60	+ 6	16.55	16.51	+.04	−.01	+.17	−.04	
	8 12 13	247.62	248.81	−1.19	+ 6	12.89	13.10	−.21	−.05	−.27	−.19	
	1915											
Yerkes: Barnard.	Apr. 7 11 5	148.46	150.11	−1.65	+ 6	13.74	13.39	+.35	+.06	−.38	−.16	A. J. XXX, 2.
	14 9 30	103.61	103.06	+0.55	+ 5	16.24	16.04	+.20	−.08	+.15	+.11	
	22 10 11	316.24	315.74	+0.50	+ 6	14.96	14.84	+.12	+.01	+.13	−.15	
	May 9 10 12	357.46	355.53	+1.93	+ 8	11.43	11.16	+.27	+.17	+.37	+.15	
	12 10 4	170.01	170.94	−0.93	+ 7	11.47	11.41	+.06	−.11	−.19	+.08	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1915–16 h m	°	°	°	m	"	"	"	"	"	"	
Yerkes: Barnard.	Oct. 21 17 41	311.09	310.76	+0.33	+ 5	15.65	15.79	−.14	−.15	+.09	+.05	A. J. XXX, 2.
	26 16 59	6.71	4.63	+2.08	+10	11.01	10.88	+.13	+.06	+.39	+.33	
	Nov. 2 18 0	298.78	300.50	−1.72	+ 7	16.18	16.40	−.22	−.21	−.49	−.50	
	Dec. 4 16 13	136.09	136.60	−0.51	+ 7	15.83	15.59	+.24	+.09	−.14	−.09	
	18 16 41	356.98	356.91	+0.07	+ 7	11.67	11.60	+.07	.00	+.01	−.05	
	Jan. 1 19 57	224.66	228.53	−3.87	+ 4	11.25	11.09	+.16	+.15	−.75	−.55	
	5 12 53	342.59	341.54	+1.05	+ 7	13.66	12.89	+.77	+.71	+.24	+.17	
	15 15 48	102.12	102.22	−0.10	+ 5	16.30	16.08	+.22	+.14	−.03	−.01	
	Feb. 2 12 45	90.25	90.90	−0.65	+ 6	15.03	14.90	+.13	+.05	−.17	−.15	
	5 17 6	257.72	257.43	+0.29	+ 5	13.36	13.36	.00	+.05	+.07	+.21	
	9 14 46	174.21	355.49	−1.28	+ 4	11.84	11.72	+.12	+.05	−.26	−.32	Observed position angle, Feb. 9, assumed 180° wrong.
	26 12 1	62.21	62.41	−0.20	+ 5	11.93	12.02	−.09	−.17	−.04	−.04	
	Mar. 4 10 58	332.87	332.39	+0.48	+ 5	13.57	13.62	−.05	−.10	+.11	+.04	
	8 11 17	104.71	105.05	−0.34	+ 9	16.56	16.28	+.28	+.19	−.10	−.08	
	15 11 25	32.50	32.70	−0.20	+ 5	10.95	10.69	+.26	+.17	−.04	−.06	
	18 12 24	203.96	202.92	+1.04	+ 8	10.92	10.64	+.28	+.20	+.19	+.39	
	22 12 50	310.88	310.17	+0.71	+ 4	15.72	15.89	−.17	−.19	+.20	+.16	
	29 13 23	260.29	260.18	+0.11	+ 7	13.49	13.55	−.06	−.01	+.03	+.16	
	Apr. 1 10 43	83.38	83.00	+0.38	+ 5	13.71	13.86	−.15	−.23	+.09	+.11	
	1 11 28	81.68	81.23	+0.45	+15	13.71	13.62	+.09	+.01	+.11	+.12	
	3 9 53	306.06	305.03	+1.03	----	------	16.17	------	------	+.29	+.26	
	5 11 2	173.90	174.91	−1.01	+ 5	11.05	11.47	−.42	−.57	−.20	−.05	
	8 11 46	346.88	347.74	−0.86	+ 5	11.85	11.94	−.09	−.15	−.18	−.24	
	12 11 14	115.68	115.44	+0.24	+ 6	16.94	16.41	+.53	+.43	+.07	+.09	
	19 11 22	56.68	56.24	+0.44	+ 8	11.21	11.34	−.13	−.21	+.09	+.09	
	May 3 10 53	277.93	278.51	−0.58	+ 4	14.81	15.28	−.47	−.43	−.15	−.09	
	6 10 35	96.19	96.33	−0.14	+ 5	15.20	15.02	+.18	+.10	−.04	−.02	
	10 9 57	202.41	202.28	+0.13	----	------	10.34	------	------	+.02	+.21	
	1916–17											
Yerkes: Barnard.	Sept.22 18 21	182.33	182.15	+0.18	+ 5	10.47	10.80	−.33	−.35	+.03	+.25	A. J. XXX, 214.
	Oct. 3 18 29	248.50	249.86	−1.36	+ 8	11.58	11.54	+.04	+.16	−.27	−.11	
	10 18 10	155.86	156.30	−0.44	+ 6	12.73	13.10	−.37	−.43	−.10	+.10	
	21 17 28	221.85	221.51	+0.34	+ 9	10.24	10.24	.00	+.08	+.06	+.27	
	26 18 35	279.39	279.27	+0.12	+ 7	14.41	14.78	−.37	−.26	+.03	+.15	
	31 17 25	316.77	316.57	+0.20	+ 9	15.74	15.54	+.20	+.29	+.05	+.12	
	Nov. 2 18 18	193.41	194.21	−0.80	+ 7	10.51	10.49	+.02	+.03	−.15	+.08	
	18 16 59	303.34	302.58	+0.76	+ 6	16.54	16.52	+.02	+.10	+.22	+.31	
	25 18 9	240.67	242.39	−1.72	+ 5	11.45	11.32	+.13	+.24	−.34	−.16	
	27 17 41	113.36	114.34	−0.98	+11	16.69	16.44	+.25	+.18	−.28	−.21	
	Dec. 2 17 47	150.93	151.11	−0.18	+ 7	14.65	14.10	+.55	+.48	−.04	+.15	
	9 16 11	105.83	106.89	−1.06	+ 7	16.22	15.99	+.23	+.17	−.30	−.26	
	16 18 37	20.10	20.56	−0.46	+ 7	10.12	10.57	−.45	−.38	−.08	−.15	
	27 14 24	92.48	93.33	−0.85	+ 5	14.86	14.63	+.23	+.17	−.22	−.23	
	30 16 34	265.05	265.12	−0.07	+ 5	13.38	13.67	−.29	−.17	−.02	+.12	
	Jan. 6 12 23	184.46	185.19	−0.73	+ 7	11.02	11.20	−.18	−.19	−.14	+.10	
	13 14 8	119.53	120.27	−0.74	+ 9	17.02	16.86	+.16	+.09	−.22	−.13	
	18 17 21	153.65	153.09	+0.56	+ 1	14.22	13.92	+.30	+.23	+.14	+.34	
	23 11 35	245.75	246.14	−0.39	+ 6	11.58	11.96	−.38	−.26	−.08	+.10	
	25 16 21	107.01	106.81	+0.20	+ 5	16.49	16.29	+.20	+.14	+.06	+.10	
	27 16 36	325.42	325.01	+0.41	+ 5	14.88	14.89	−.01	+.09	+.11	+.16	
	Feb. 8 16 0	313.45	314.78	−1.33	+ 7	16.10	16.00	+.10	+.19	−.37	−.30	
	10 13 0	205.67	208.04	−2.37	+ 7	10.40	10.63	−.23	−.18	−.44	−.21	
	13 11 6	30.47	29.80	+0.67	+ 5	10.61	10.63	−.02	+.03	+.12	+.04	
	17 12 55	131.78	132.36	−0.58	+ 6	16.38	16.17	+.21	+.13	−.16	−.02	
	20 11 49	311.99	311.68	+0.31	+ 5	15.99	16.21	−.22	−.14	+.09	+.17	
	27 10 6	266.51	267.01	−0.50	+ 5	13.87	14.12	−.25	−.13	−.12	+.02	
	Mar.17 14 30	226.51	227.44	−0.93	+ 5	10.78	10.90	−.12	−.02	−.18	+.02	
	20 10 34	56.43	56.36	+0.07	+ 6	11.24	11.30	−.06	−.06	+.01	−.07	
	22 11 31	285.74	287.64	−1.90	0	15.95	16.23	−.28	−.19	−.54	−.43	
	24 12 33	144.84	144.97	−0.13	+ 3	15.02	14.52	+.50	+.43	−.03	+.15	
	27 10 14	326.39	326.77	−0.38	+ 5	14.17	14.29	−.12	−.02	−.09	−.05	
	Apr. 10 9 39	199.00	199.97	−0.97	+ 5	10.25	10.49	−.24	−.21	−.18	+.05	
	May 1 10 7	342.41	342.53	−0.12	+ 5	12.15	12.36	−.21	−.11	−.03	−.03	
	8 10 29	288.82	289.96	−1.14	+ 5	15.34	15.95	−.61	−.52	−.32	−.22	
	1917											
Yerkes: Barnard.	Nov.10 18 26	29.52	29.10	+0.42	+ 6	10.11	10.13	−.02	+.01	+.07	−.06	A. J. XXXII, 103.
	Dec. 5 17 23	302.30	302.36	−0.06	+ 8	16.54	16.65	−.11	−.07	−.02	.00	
	6 15 34	260.19	258.76	+1.43	+ 9	12.42	12.40	+.02	+.16	+.31	+.48	
	8 17 1	------	120.59	------	+ 7	16.75	16.65	+.10	−.08	------	------	
	15 16 52	61.44	60.43	+1.01	+ 8	11.22	11.05	+.17	+.12	+.19	+.05	
	25 12 28	154.02	155.95	−1.93	+ 7	13.61	13.79	−.18	−.38	−.46	−.23	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	$s \sin dp$ O−C	$s \sin dp$ v	Remarks.
	1918 h m	°	°	°	m	″	″	″	″	″	″	
Yerkes: Barnard.	Jan. 8 13 46	26.18	26.27	−0.09	+7	10.66	10.48	+.18	+.21	−.02	−.15	
	19 13 36	88.58	88.48	+0.10	+9	13.84	13.81	+.03	−.09	+.02	−.08	
	29 13 13	167.17	171.07	−3.90	+6	12.20	12.22	−.02	−.18	−.83	−.54	
	31 15 33	65.97	66.59	−0.62	+7	11.80	11.73	+.07	.00	−.13	−.27	
	Feb. 16 11 49	153.52	151.70	+1.82	+8	14.86	14.22	+.64	+.43	+.45	+.67	
	23 12 22	103.75	103.60	+0.15	+6	15.48	15.73	−.25	−.40	+.04	−.01	
	28 15 6	134.17	133.85	+0.32	+5	16.45	16.15	+.30	+.09	+.09	+.21	
	Mar. 2 13 30	17.71	18.11	−0.40	+5	10.43	10.65	−.22	−.18	−.07	−.19	
	7 15 8	85.58	85.49	+0.09	+5	13.86	13.58	+.28	+.17	+.02	−.09	
	16 12 36	258.20	260.72	−2.52	+4	12.72	13.03	−.31	−.17	−.57	−.41	
	19 13 22	76.72	74.57	+2.15	+7	12.80	12.40	+.40	+.31	+.47	+.34	
	23 11 14	169.34	169.85	−0.51	+5	12.22	12.09	+.13	−.03	−.11	+.17	
	26 11 6	346.22	345.90	+0.32	+6	12.18	12.43	−.25	−.19	+.07	+.01	
	30 12 14	113.70	114.29	−0.59	+4	17.08	16.42	+.66	+.49	−.17	−.17	
	Apr. 4 13 23	148.04	149.15	−1.11	+5	14.33	14.17	+.16	−.04	−.27	−.07	
	13 10 54	325.27	325.05	+0.22	+5	14.44	14.58	−.14	−.10	+.06	+.04	
	23 10 16	97.69	96.83	+0.86	+4	14.72	14.65	+.07	−.07	+.22	+.15	
	1918–19											
Yerkes: Barnard.	Nov. 26 15 51	107.36	107.80	−0.44	+4	15.48	15.39	+.09	−.06	−.12	−.11	A. J. XXXII, 103.
	30 15 42	------	------	-----	+5	10.04	10.09	−.05	−.02	----	----	
	Dec. 5 15 36	279.79	279.81	−0.02	+5	14.20	14.48	−.28	−.24	−.01	−.01	
	7 15 4	137.39	138.25	−0.86	+5	15.94	15.97	−.03	−.21	−.24	−.09	
	Jan. 18 11 54	108.71	109.82	−1.11	+6	16.19	16.03	+.16	.00	−.31	−.29	
	28 15 56	189.93	189.96	−0.03	+4	11.33	10.95	+.38	+.34	−.01	+.23	
	30 15 29	91.28	90.89	+0.39	+5	13.80	13.80	.00	−.13	+.09	+.04	
	Feb. 1 10 35	318.57	318.77	−0.20	+7	15.99	16.03	−.04	−.05	−.06	−.11	
	4 11 40	132.31	134.40	−2.09	+7	16.76	16.42	+.34	+.16	−.60	−.46	
	6 14 26	359.70	359.76	−0.06	+6	11.31	11.56	−.25	−.23	−.01	−.11	
	11 14 5	79.46	79.28	+0.18	+7	12.74	12.54	+.20	+.09	+.04	−.04	
	15 10 51	175.54	177.12	−1.58	+7	11.70	11.76	−.06	−.15	−.32	−.08	
	18 13 11	345.82	345.78	+0.04	+5	12.65	12.76	−.11	−.09	+.01	−.07	
	25 12 1	296.98	297.17	−0.19	+5	16.99	16.64	+.35	+.34	−.06	−.10	
	Mar. 1 12 0	57.24	57.24	0.00	+7	11.12	10.93	+.19	+.12	.00	−.11	
	6 12 24	109.71	109.12	+0.59	+5	16.26	16.02	+.24	+.08	+.17	+.19	
	11 12 17	145.02	144.30	+0.72	+5	15.49	15.18	+.31	+.13	+.19	+.36	
	18 11 32	100.41	99.81	+0.60	+4	15.19	14.93	+.26	+.12	+.16	+.14	
	22 10 30	201.16	202.10	−0.94	+5	10.23	10.42	−.19	−.18	−.17	+.05	
	27 12 38	266.88	267.79	−0.91	+4	13.28	13.44	−.16	−.10	−.21	−.18	
	Apr. 1 10 22	311.23	309.57	+1.66	+4	16.44	16.37	+.07	+.05	+.47	+.42	
	12 12 18	342.20	341.51	+0.69	+4	12.91	12.88	+.03	+.05	+.15	+.07	
	22 9 47	114.67	113.93	+0.74	+5	16.13	16.08	+.05	−.11	+.21	+.25	
	1918–19											
U. S. Naval Obs.: A. Hall, jr.	Dec. 17 14 10	268.07	269.80	−1.73	+3	13.34	13.36	−.02	−.07	−.40	−.21	A. J. XXXII, 115.
	18 14 59	179.32	180.74	−1.42	−2	11.72	11.37	+.35	+.12	−.28	−.39	
	19 14 3	130.86	130.26	+0.60	+1	16.86	16.61	+.25	+.10	+.17	−.13	
	28 15 42	299.72	300.68	−0.96	+3	16.86	16.71	+.15	+.09	−.28	−.15	
	29 14 8	253.64	253.48	+0.16	+2	12.42	11.78	+.64	+.53	+.03	+.21	
	Jan. 6 14 13	116.64	115.92	+0.72	+3	16.37	16.50	−.13	−.29	+.21	−.10	
	20 12 36	324.60	325.88	−1.28	+2	15.24	15.23	+.01	−.08	−.34	−.28	
	21 11 36	286.90	287.73	−0.83	+1	15.93	15.84	+.09	+.05	−.23	−.07	
	24 12 30	105.11	103.35	+1.76	+9	15.24	15.32	−.08	−.23	+.47	+.18	
	26 13 39	318.30	318.59	−0.29	0	16.03	16.04	−.01	−.10	−.08	.00	
	27 11 59	282.11	281.50	+0.61	+1	15.29	15.14	+.15	+.11	+.16	+.34	
	29 15 3	135.48	133.73	+1.75	−1	16.50	16.47	+.03	−.12	+.50	+.20	
	30 11 53	100.48	98.73	+1.75	+4	14.71	14.78	−.07	−.21	+.45	+.17	
	31 15 0	8.48	8.01	+0.47	+5	11.75	11.06	+.69	+.67	+.09	+.06	
	Feb. 1 13 34	313.10	313.72	−0.62	0	16.60	16.46	+.14	+.05	−.18	−.09	
	5 14 40	87.70	85.64	+2.06	+2	13.12	13.22	−.10	−.21	+.48	+.23	
	6 12 57	6.13	4.88	+1.25	+7	11.57	11.23	+.34	+.32	+.25	+.23	
	10 11 48	129.27	129.34	−0.07	+1	17.02	16.71	+.31	+.16	−.02	−.33	
	19 11 9	303.37	303.28	+0.09	+1	16.80	16.82	−.02	−.09	+.03	+.15	
	24 11 10	344.70	343.28	+1.42	+1	12.64	12.98	−.34	−.40	+.32	+.35	
	26 12 32	239.06	240.66	−1.60	+5	11.16	11.11	+.05	−.10	−.31	−.15	
	Mar. 3 10 55	293.11	294.11	−1.00	−4	17.16	16.46	+.70	+.65	−.29	−.14	
	24 10 23	97.60	96.13	+1.47	−1	14.18	14.48	−.30	−.43	+.37	+.10	
	25 10 27	17.19	16.43	+0.76	+1	10.16	10.55	−.39	−.40	+.14	+.09	
	Apr. 2 9 58	265.65	267.10	−1.45	+1	13.40	13.35	+.05	−.02	−.34	−.15	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. −Aber. Time.	Position Angle. O	Position Angle. C	dp O−C	Δt	Distance. O	Distance. C	ds O−C	ds v	s sin dp O−C	s sin dp v	Remarks.
	1919–20 h m	°	°	°	m	"	"	"	"	"	"	
Yerkes: Barnard.	Dec. 30 13 33	135.98	135.98	0.00	+ 4	16.46	16.43	+.03	−.14	.00	−.10	Communicated by Prof. E. B. Frost.
	Jan. 10 13 3	174.38	175.97	−1.59	0	11.80	11.87	−.07	−.19	−.33	−.29	
	13 14 10	350.23	348.47	+1.76	+ 4	12.80	12.64	+.16	+.10	+.39	+.23	
	17 13 9	123.12	122.71	+0.41	+ 9	16.71	16.77	−.06	−.21	+.12	−.02	
	24 15 57	51.91	49.45	+2.46	----	------	10.36	----	----	+.45	+.32	
	27 14 46	232.41	228.32	+4.09	+ 7	10.04	10.33	−.29	−.27	+.74	+.76	
	29 14 24	111.93	110.98	+0.95	+ 3	16.04	15.93	+.11	−.01	+.26	+.11	
	31 14 26	147.55	327.80	−0.25	+ 5	15.46	15.18	+.28	+.21	−.07	−.26	
	Feb. 10 13 0	102.11	102.58	−0.47	+ 3	15.00	14.96	+.04	−.07	−.12	−.28	Observed position angle, Jan. 31, assumed 180° wrong.
	12 15 56	316.15	314.87	+1.28	+ 4	16.55	16.50	+.05	−.03	+.37	+.16	
	19 13 44	271.03	271.37	−0.34	+ 5	13.46	13.55	−.09	−.08	−.08	−.20	
	26 13 42	186.98	175.87	+0.11	+ 5	12.38	11.86	+.52	+.40	+.02	+.06	
	28 11 4	88.10	86.97	+1.13	+ 6	13.12	13.03	+.09	.00	+.26	+.11	
	Mar. 2 13 36	254.94	255.68	−0.74	+ 7	11.98	11.89	+.09	+.12	−.15	−.21	Observed position angle, Feb. 26, 11° too large; letter from Yerkes.
	4 12 42	124.13	123.53	+0.60	+ 7	16.91	16.75	+.16	+.01	+.18	+.05	
	6 11 23	349.85	349.67	+0.18	+ 6	12.56	12.41	+.15	+.09	+.04	−.12	
	9 11 8	165.93	166.30	−0.37	+ 6	13.15	12.75	+.40	+.26	−.08	−.10	
	13 12 2	297.90	297.54	+0.36	+ 5	16.43	16.47	−.04	−.09	+.10	−.10	
	20 12 7	228.93	229.46	−0.53	+ 6	10.33	10.39	−.06	−.04	−.10	−.08	
	21 11 13	152.66	152.09	+0.57	+ 6	14.56	14.36	+.20	+.03	+.14	+.11	
	Apr. 13 9 9	193.31	193.52	−0.21	+ 6	10.53	10.54	−.01	−.08	−.04	+.02	
	1919–20											
U. S. Naval Obs.: A. Hall, jr.	Nov. 5 17 23	274.43	275.33	−0.90	0	13.52	13.30	+.22	.00	−.21	−.13	A. J. XXXIII, 62.
	16 16 44	307.85	308.33	−0.48	+ 1	16.65	16.42	+.23	+.07	−.14	.00	
	22 16 31	304.19	304.13	+0.06	+ 4	16.84	16.43	+.41	+.24	+.02	+.16	
	24 16 17	165.05	165.43	−0.38	0	13.10	12.74	+.36	+.32	−.08	−.17	
	Dec. 1 15 12	118.52	119.26	−0.74	+ 2	16.52	16.28	+.24	+.13	−.21	−.15	
	3 16 11	334.92	335.33	−0.41	+ 4	13.76	14.07	−.31	−.43	−.10	−.01	
	4 16 20	294.56	295.03	−0.47	+ 5	16.52	15.94	+.58	+.39	−.13	.00	
	Jan. 14 12 24	305.82	306.17	−0.35	+ 2	16.88	16.84	+.04	−.12	−.10	+.04	
	29 12 1	113.52	114.97	−1.45	+ 2	16.40	16.34	+.06	−.06	−.41	−.34	
	Feb. 13 13 18	278.82	278.95	−0.13	+10	14.22	14.47	−.25	−.47	−.03	+.07	
	19 11 9	276.53	277.19	−0.66	+ 3	14.72	14.29	+.43	+.21	−.17	−.07	
	25 11 42	268.08	269.08	−1.00	− 1	13.58	13.30	+.28	+.05	−.23	−.17	
	Mar. 21 11 1	153.27	152.51	+0.76	−13	13.76	14.21	−.45	−.48	+.19	+.13	
	22 11 17	112.90	111.42	+1.48	−10	15.92	15.97	−.05	−.17	+.41	+.48	
	23 11 21	45.39	46.61	−1.22	+ 2	10.29	10.31	−.02	−.14	−.22	−.17	
	24 12 28	326.31	326.60	−0.29	+ 1	15.23	14.99	+.24	+.12	−.08	+.03	
	Apr. 10 10 30	15.36	14.00	+1.36	0	10.50	10.51	−.01	−.11	+.25	+.30	
	May 4 9 56	338.61	339.14	−0.53	0	13.62	13.14	+.48	+.37	−.12	−.04	
	1920–21											
Yerkes: Barnard.	Nov. 4 15 51	228.20	229.87	−1.67	+ 2	9.21	9.70	−.49	−.35	−.28	−.02	Communicated by Prof. E. B. Frost.
	13 17 18	25.94	24.59	+1.35	+ 7	10.18	9.86	+.32	+.34	+.23	+.09	
	27 18 11	265.48	265.38	+0.10	+ 5	11.39	11.92	−.53	−.29	+.02	+.08	
	Dec. 11 16 42	122.01	121.98	+0.03	+ 7	16.63	16.37	+.26	+.16	+.01	−.07	
	16 15 13	158.62	160.01	−1.39	+ 6	14.04	13.69	+.35	+.13	−.33	−.15	
	Jan. 3 14 23	143.80	144.43	−0.63	+ 6	16.07	15.79	+.28	+.07	−.17	−.10	
	8 18 6	185.82	186.54	−0.72	+ 6	11.36	11.05	+.31	+.20	−.14	+.17	
	11 14 26	15.55	14.67	+0.88	+ 6	10.66	10.58	+.08	+.10	+.16	+.01	
	22 14 30	85.32	84.32	+1.00	+ 6	12.14	12.25	−.11	−.13	+.21	+.07	
	27 15 7	124.73	124.61	+0.12	+ 3	16.73	16.79	−.06	−.19	+.04	−.02	
	Feb. 5 14 24	300.13	298.72	+1.41	+ 6	16.25	16.45	−.20	−.08	+.40	+.24	
	15 13 3	49.00	47.43	+1.57	+ 6	10.21	10.15	+.06	+.06	+.28	+.14	
	17 12 21	292.64	292.22	+0.42	+ 5	15.86	15.83	+.03	+.18	+.12	−.01	
	19 12 27	149.72	148.51	+1.21	+ 8	15.44	15.22	+.22	.00	+.32	+.43	
	Mar. 1 14 12	276.24	277.04	−0.80	+ 8	13.76	13.88	−.12	+.10	−.19	−.22	
	8 14 35	181.04	180.85	+0.19	+ 6	11.86	11.45	+.41	+.27	+.04	+.34	
	10 13 30	90.32	88.02	+2.30	+ 5	12.68	12.79	−.11	−.14	+.52	+.38	
	10 13 41	88.83	87.53	+1.30	+ 4	12.72	12.74	−.02	−.05	+.29	+.15	
	15 14 43	123.85	125.36	−1.51	+ 7	16.52	16.69	−.17	−.31	−.44	−.49	
	17 12 44	353.75	352.95	+0.80	+ 5	12.10	12.11	−.01	+.01	+.17	+.01	
	19 11 6	261.57	262.46	−0.89	+ 6	11.92	12.18	−.26	−.02	−.19	−.12	
	22 10 16	81.99	80.58	+1.41	+ 5	12.00	12.00	.00	−.02	+.30	+.16	
	24 12 29	302.72	301.93	+0.79	+ 8	16.45	16.52	−.07	+.03	+.23	+.05	
	29 10 36	341.86	342.87	−1.01	+ 7	13.11	13.14	−.03	.00	−.23	−.41	
	31 13 55	231.57	232.12	−0.55	+ 6	10.08	10.22	−.14	+.02	−.10	+.16	
	Apr. 2 10 35	117.11	117.88	−0.77	+ 5	16.31	16.22	+.09	−.01	−.22	−.30	
	7 12 32	147.72	149.05	−1.33	+ 8	15.07	14.81	+.26	+.04	−.34	−.20	

TABLE I.—*Comparison of Observations with Theory*—Continued.

Observatory and Observer.	Greenwich M. T. —Aber. Time.	Position Angle.		dp	Δt	Distance.		ds		$s \sin dp$		Remarks.
		O	C	O−C		O	C	O−C	v	O−C	v	
	1920–21 h m	°	°	°	m	"	"	"	"	"	"	
U. S. Naval Obs.: A. Hall, jr.	Dec. 14 14 49	301.80	302.59	−0.79	+ 3	16.49	16.44	+.05	−.16	−.23	+.04	A. J. XXXIV, 18.
	17 14 50	120.32	120.24	+0.08	+ 5	15.98	16.29	−.31	−.37	+.02	+.08	
	20 14 10	298.58	298.95	−0.37	+ 5	16.44	16.21	+.23	+.02	−.10	+.17	
	31 14 57	325.24	326.02	−0.78	− 3	15.38	15.56	−.18	−.45	−.21	+.04	
	Jan. 3 12 43	147.20	147.35	−0.15	− 1	15.24	15.41	−.17	−.25	−.04	−.14	
	6 13 3	322.97	324.18	−1.21	−10	15.40	15.77	−.37	−.63	−.33	−.08	
	12 13 25	317.45	318.70	−1.25	+ 2	16.39	16.36	+.03	−.22	−.36	−.10	
	27 11 37	129.59	129.95	−0.36	− 1	16.70	16.84	−.14	−.20	−.11	−.11	
	Feb. 11 10 24	299.10	300.33	−1.23	+ 1	16.93	16.59	+.34	+.12	−.36	−.09	
	14 11 39	117.00	115.91	+1.09	0	16.40	16.23	+.17	+.12	+.31	+.40	
	16 12 58	329.61	330.32	−0.71	− 1	15.40	14.97	+.43	+.15	−.19	+.06	
	25 10 28	146.71	146.70	+0.01	+11	15.74	15.43	+.31	+.24	.00	−.10	
	Mar. 1 9 48	285.42	286.06	−0.64	+ 4	15.84	15.08	+.76	+.54	−.17	+.09	
	7 10 7	278.45	279.48	−1.03	− 1	14.55	14.24	+.31	+.08	−.26	−.02	
	13 13 29	261.53	264.07	−2.54	+10	12.38	12.33	+.05	−.21	−.53	−.35	
	18 11 41	307.12	307.76	−0.64	+ 3	17.38	16.68	+.70	+.47	−.19	+.08	
	25 9 16	258.49	259.15	−0.66	+ 7	12.18	11.84	+.34	+.07	−.14	+.02	
	29 9 18	344.74	346.17	−1.43	0	13.36	12.73	+.63	+.35	−.32	−.06	
	Apr. 1 10 7	161.29	160.48	+0.81	− 3	13.40	13.37	+.03	−.07	+.19	+.05	
	4 10 5	336.39	337.17	−0.78	− 1	14.17	13.77	+.40	+.12	−.19	+.06	
	5 10 21	295.17	295.86	−0.69	+ 2	16.42	16.05	+.37	+.16	−.19	+.08	
	6 9 33	235.47	237.77	−2.30	0	10.57	10.41	+.16	−.13	−.42	−.36	
	11 10 23	290.08	290.80	−0.72	+ 6	16.00	15.48	+.52	+.31	−.19	+.07	
	1921–22											
Yerkes: Barnard.	Dec. 3 15 12	203.06	204.57	−1.51	+ 7	10.42	9.87	+.55	+.44	−.26	−.10	Communicated by Prof. E. B. Frost.
	24 14 39	351.58	351.23	+0.35	+11	12.95	12.44	+.51	+.35	+.08	−.13	
	27 13 31	170.33	170.33	0.00	+ 8	12.41	12.55	−.14	−.37	.00	+.09	
	31 13 40	304.92	304.72	+0.20	+ 1	16.41	16.55	−.14	−.17	+.06	−.18	
	Jan. 5 13 15	341.63	340.37	+1.26	+ 7	14.68	13.85	+.83	+.69	+.30	+.05	
	5 15 41	336.75	335.32	+1.43	+ 8	14.53	14.56	−.03	−.16	+.36	+.10	
	14 13 48	150.79	150.49	+0.30	+12	15.59	15.25	+.34	+.10	+.08	+.10	
	17 14 42	327.41	326.32	+1.09	+ 7	15.71	15.76	−.05	−.16	+.30	+.02	
	21 12 58	108.90	108.45	+0.45	+ 6	15.28	14.90	+.38	+.31	+.12	+.13	
	26 13 29	140.92	141.02	−0.10	+ 8	16.57	16.34	+.23	+.03	−.03	−.04	
	28 12 9	23.01	21.55	+1.46	+ 8	10.32	10.24	+.08	−.11	+.26	+.17	
	Feb. 9 12 59	358.57	357.74	+0.83	+ 7	12.02	11.82	+.20	+.02	+.17	−.01	
	14 11 13	82.65	84.68	−2.03	+ 7	12.19	12.01	+.18	+.10	−.43	−.39	
	16 12 51	307.07	306.08	+0.99	+ 6	16.55	16.75	−.20	−.24	+.29	+.04	
	18 10 36	171.60	171.91	−0.31	+ 6	12.17	12.40	−.23	−.46	−.07	+.03	
	25 11 46	121.40	120.86	+0.54	+ 8	16.66	16.44	+.22	+.11	+.15	+.14	
	Mar. 2 14 23	150.29	150.13	+0.16	+ 8	15.95	15.15	+.80	+.56	+.04	+.06	
	4 11 8	52.15	53.45	−1.30	+ 8	10.04	10.08	−.04	−.19	−.23	−.22	
	7 11 15	227.86	226.81	+1.05	+ 7	9.83	9.95	−.12	−.17	+.18	+.33	
	11 11 1	329.40	328.20	+1.20	+ 7	15.53	15.34	+.19	+.08	+.32	+.04	
	21 10 59	101.24	100.86	+0.38	+ 7	14.07	14.00	+.07	.00	+.09	+.12	
	Apr. 15 10 8	343.79	343.06	+0.73	+ 5	12.77	13.13	−.36	−.51	+.17	−.07	
	18 10 52	157.90	158.00	−0.10	+ 8	13.96	13.76	+.20	−.01	−.02	+.04	
	29 10 34	217.95	219.13	−1.18	+ 8	9.65	9.71	−.06	−.12	−.20	−.04	
	May 4 12 26	281.98	281.59	+0.39	+ 6	13.68	13.83	−.15	−.11	+.09	−.01	
	6 12 20	138.08	139.02	−0.94	+ 6	16.15	15.85	+.30	+.10	−.26	−.27	
	9 10 15	321.01	320.00	+1.01	+ 7	15.68	15.75	−.07	−.16	+.28	+.01	
	1923											
U. S. Naval Obs.: A. Hall, jr.	Feb. 21 11 1	316.75	318.02	−1.27	+ 5	16.92	16.63	+.29	+.04	−.37	−.20	A. J. XXXV, 108.
	Mar. 5 10 8	309.00	310.46	−1.46	0	16.75	16.78	−.03	−.28	−.43	−.29	
	10 13 18	340.68	340.66	+0.02	− 4	14.34	13.79	+.55	+.34	.00	+.22	
	14 9 57	124.73	124.03	+0.70	0	16.37	16.48	−.11	−.17	+.20	+.08	
	17 9 42	301.69	302.12	−0.43	0	16.76	16.32	+.44	+.18	−.12	−.01	
	Apr. 6 9 54	141.95	142.44	−0.49	− 1	15.92	15.96	−.04	−.05	−.14	−.32	
	9 9 12	321.13	321.20	−0.07	− 1	16.57	16.05	+.52	+.27	−.02	+.16	
	20 9 38	359.61	359.09	+0.52	− 2	11.68	11.39	+.29	+.15	+.10	+.32	
	21 9 45	309.34	311.34	−2.00	− 2	16.34	16.44	−.10	−.35	−.57	−.43	
	May 3 9 30	303.91	302.81	+1.10	+ 3	16.45	16.03	+.42	+.17	+.31	+.42	
	6 9 47	121.20	120.06	+1.14	0	15.80	15.78	+.02	+.06	+.31	+.21	
	19 9 48	32.18	33.24	−1.06	+ 4	9.24	9.49	−.25	−.28	−.18	−.01	

EQUATIONS OF CONDITION AND NORMAL EQUATIONS.

Each complete observation of Table I gave two equations of condition between the corrections to the assumed elements of the form:

$$\begin{aligned} s \sin dp = & \, r \sin \tau \cdot \sin du_{\oplus} \\ & + (r \sin \tau \cos I + r \cos \tau \cos u_{\oplus} \sin I) \cdot \sin dN \\ & - r \cos \tau \sin u_{\oplus} \cdot \sin dI \\ & - r \sin \tau \cos u_{\oplus} \cdot 2e \sin Q \\ & + r \sin \tau \sin u_{\oplus} \cdot 2e \cos Q \end{aligned}$$

$$\begin{aligned} ds = & \, r \cos \sigma \cos \tau \cdot \sin du_{\oplus} \\ & + r \cos \sigma \sin p \cos \delta \cdot \sin dN \\ & + r \cos \sigma \sin \tau \sin u_{\oplus} \cdot \sin dI \\ & - (r \cos \sigma \cos \tau \cos u_{\oplus} + \tfrac{1}{2} s \sin u_{\oplus}) \cdot 2e \sin Q \\ & + (r \cos \sigma \cos \tau \sin u_{\oplus} - \tfrac{1}{2} s \cos u_{\oplus}) \cdot 2e \cos Q \\ & + s \cdot \frac{da}{a} \end{aligned}$$

where

$$\sin \tau = \frac{r}{s} \sin B$$

$$\cos \tau = \frac{r}{s} \cos B \sin (u_{\oplus} - U)$$

$$\cos \sigma = \cos B \cos (u_{\oplus} - U)$$

In the above e is the assumed unknown eccentricity of the satellite's orbit and Q is the longitude of the periastron measured from the same node as $u_{\oplus}$.

Before forming the normal equations, new unknowns were substituted for those contained in the above equations to facilitate the numerical work. The quantities substituted for the six unknowns, $\sin du_{\oplus}$, $\sin dN$, $\sin dI$, $2e \sin Q$, $2e \cos Q$, and $\frac{da}{a}$, are given in the columns two to seven of Table II, one line being given to each set of equations of condition. The last column gives the probable error of a single equation.

TABLE II.—*Transformation of Unknowns.*

		Sin $du_{\oplus}$	Sin dN	Sin dI	$2e$ sin Q	$2e$ cos Q	da/a	r
								$''$
1889,	Leander McCormick, Parrish.	1/2 x	4/5 y	9/10 z	7/10 u	7/10 v	3/5 w	0.392
1891–92,	U. S. Naval, A. Hall, jr.	1/2 x	4/5 y	4/5 z	7/10 u	3/5 v	9/20 w	0.265
1892–93,	Lick, Barnard.	9/20 x	7/10 y	4/5 z	1/2 u	1/2 v	1/3 w	0.155
1893–94,	Lick, Barnard.	1/2 x	4/5 y	4/5 z	11/20 u	1/2 v	3/10 w	0.130
1894–95,	Lick, Barnard.	1/2 x	4/5 y	4/5 z	7/10 u	3/5 v	9/20 w	0.113
	Schaeberle.	1/2 x	1/1 y	7/10 z	9/10 u	1/2 v	1/2 w	0.097
1895–96,	Lick, Schaeberle.	1/2 x	9/10 y	4/5 z	4/5 u	3/5 v	1/2 w	0.077
1896–97,	Lick, Schaeberle.	2/5 x	3/5 y	3/4 z	1/2 u	9/20 v	1/3 w	0.096
	Lowell, Drew.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	1/2 w	0.261
1897–98,	Lick, Schaeberle.	1/2 x	1/1 y	4/5 z	9/10 u	1/2 v	1/2 w	0.082
	Yerkes, Barnard.	2/5 x	7/10 y	3/5 z	3/5 u	2/5 v	1/3 w	0.147
	U. S. Naval, Brown.	9/20 x	4/5 y	7/10 z	7/10 u	1/2 v	2/5 w	0.136
1898–99,	Yerkes, Barnard.	2/5 x	7/10 y	3/5 z	3/5 u	2/5 v	1/3 w	0.120
	Lick, Aitken.	1/2 x	1/1 y	7/10 z	1/1 u	1/2 v	1/2 w	0.128
	Hussey.	1/2 x	1/1 y	1/1 z	7/10 u	3/5 v	2/5 w	0.186
	Lowell, Drew.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	1/2 w	0.170
	Pulkowa, photographs.	2/5 x	4/5 y	3/5 z	4/5 u	1/2 v	2/5 w	0.147
1899–1900,	Lick, Hussey.	1/2 x	9/10 y	1/1 z	7/10 u	3/5 v	2/5 w	0.127
	Pulkowa, photographs.	1/2 x	4/5 y	1/1 z	7/10 u	3/5 v	2/5 w	0.128
	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	2/5 w	0.118
	U. S. Naval, See.	1/2 x	4/5 y	3/4 z	3/4 u	1/2 v	2/5 w	0.215
1900–01,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	9/20 w	0.134
	Pulkowa, photographs.	1/2 x	1/1 y	3/5 z	1/1 u	1/2 v	1/2 w	0.153
1901–02,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	2/5 w	0.126
	Lick, photographs.	1/2 x	1/1 y	3/4 z	3/4 u	1/2 v	2/5 w	0.136
	Aitken.	1/2 x	1/1 y	4/5 z	4/5 u	1/2 v	2/5 w	0.131
1902–03,	Strasburg, Wirtz.	1/2 x	1/1 y	4/5 z	4/5 u	1/2 v	2/5 w	0.339
	Yerkes, Barnard.	1/2 x	1/1 y	4/5 z	9/10 u	1/2 v	1/2 w	0.119
	U. S. Naval, Dinwiddie.	9/20 x	4/5 y	4/5 z	2/3 u	1/2 v	1/3 w	0.193
1903–04,	Yerkes, Barnard.	1/2 x	1/1 y	7/10 z	9/10 u	1/2 v	1/2 w	0.150
1904–05,	Yerkes, Barnard.	1/2 x	1/1 y	4/5 z	4/5 u	1/2 v	2/5 w	0.135
	U. S. Naval, Hammond.	1/2 x	1/1 y	9/10 z	9/10 u	1/2 v	9/20 w	0.196
	Rice.	1/2 x	1/1 y	4/5 z	9/10 u	1/2 v	1/2 w	0.130
1905–06,	Yerkes, Barnard.	1/2 x	1/1 y	3/4 z	9/10 u	1/2 v	1/2 w	0.170
	U. S. Naval, Hammond.	2/5 x	3/4 y	3/4 z	7/10 u	9/20 v	1/3 w	0.123
1906–07,	Yerkes, Barnard.	1/2 x	1/1 y	9/10 z	9/10 u	3/5 v	1/2 w	0.098

TABLE II.—*Transformation of Unknowns*—Continued.

		Sin $du_\oplus$	Sin dN	Sin dI	$2e$ sin Q	$2e$ cos Q	da/a	r
								$''$
1907–08,	U. S. Naval, Hammond.	2/5 x	2/3 y	4/5 z	1/2 u	2/5 v	3/10 w	0.126
	Yerkes, Barnard.	1/2 x	1/1 y	4/5 z	9/10 u	1/2 v	9/20 w	0.118
1908–09,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	2/5 w	0.150
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	4/5 z	3/4 u	1/2 v	1/2 w	0.214
1909–10,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	1/2 v	2/5 w	0.168
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	4/5 z	3/4 u	3/5 v	2/5 w	0.200
1910–11,	Yerkes, Barnard.	1/2 x	9/10 y	3/4 z	4/5 u	1/2 v	2/5 w	0.174
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	4/5 z	3/5 u	1/2 v	2/5 w	0.128
	Burton.	1/2 x	9/10 y	9/10 z	3/4 u	1/2 v	2/5 w	0.156
1911–12,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	4/5 u	1/2 v	2/5 w	0.129
	U. S. Naval, Burton.	1/2 x	9/10 y	4/5 z	3/4 u	1/2 v	2/5 w	0.086
1912–13,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	1/2 v	2/5 w	0.148
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	9/10 z	3/5 u	1/2 v	2/5 w	0.145
	Burton.	1/2 x	9/10 y	4/5 z	3/5 u	1/2 v	2/5 w	0.104
1913–14,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	3/5 v	2/5 w	0.150
1914–15,	Yerkes, Barnard.	1/2 x	9/10 y	3/5 z	9/10 u	1/2 v	2/5 w	0.126
1915–16.	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	1/2 v	2/5 w	0.167
1916–17,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	3/5 v	2/5 w	0.148
1917–18,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	3/5 v	2/5 w	0.178
1918–19,	Yerkes, Barnard.	1/2 x	9/10 y	4/5 z	3/4 u	3/5 v	2/5 w	0.131
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	4/5 z	3/5 u	3/5 v	2/5 w	0.181
1919–20,	Yerkes, Barnard.	1/2 x	9/10 y	3/4 z	2/3 u	3/5 v	1/2 w	0.147
	U. S. Naval, A. Hall, jr.	1/2 x	4/5 y	4/5 z	3/5 u	3/5 v	2/5 w	0.168
1920–21,	Yerkes, Barnard.	1/2 x	4/5 y	4/5 z	3/5 u	3/5 v	2/5 w	0.138
	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	4/5 z	3/5 u	3/5 v	2/5 w	0.166
1921–22,	Yerkes, Barnard.	1/2 x	9/10 y	2/3 z	7/10 u	1/2 v	2/5 w	0.160
1922–23,	U. S. Naval, A. Hall, jr.	1/2 x	9/10 y	3/5 z	3/5 u	1/2 v	1/3 w	0.188

In the case of the photographic observations made at the Lick Observatory in 1902, where the number of exposures on the satellite during a given night varied from 2 to 17, in the formation of the normal equations the result for each night was weighted as follows: 2 or 3 exposures, January 4 and 8, weight 1 each; 5, 6, or 7 exposures, January 6, 9, 11, 12, and 16, weight 2 each; 17 exposures, January 17, weight 4. For all the other observatories each result published in Table I was given weight 1.

Normal Equations and Solutions.

1889–90. LEANDER McCORMICK OBSERVATORY; PARRISH.

$+386.5x$	$-136.3y$	$-59.4z$	$+32.5u$	$-78.6v$	$+73.1w$	=	$+1.8$
	$+366.3$	$+37.4$	$+35.2$	-32.9	-187.4	=	-1.7
		$+372.3$	-56.0	$+56.6$	-82.1	=	-6.0
			$+464.5$	$+270.1$	$+52.8$	=	-2.6
				$+406.6$	$+111.3$	=	-8.8
					$+333.8$	=	-3.3
					$[nn]$	=	2.70

$x=-0.0070\pm0.0238$	$du=-0^\circ.20\pm0^\circ.18$
$y=-0.0166\pm0.0265$	$dN=-0^\circ.76\pm1^\circ.21$
$z=-0.0127\pm0.0228$	$dI=-0^\circ.65\pm1^\circ.17$
$u=+0.0117\pm0.0267$	$Q=156^\circ.3\pm41^\circ.7$
$v=-0.0266\pm0.0307$	$e=0.0102\pm0.0128$
$w=-0.0137\pm0.0280$	$da=-0''.134\pm0''.274$
$[vv]=2.37$	$r=0''.392$
$[nn.6]=2.35$	

1891–92. U. S. NAVAL OBSERVATORY; A. HALL, JR.

$+1199.9x$	$-335.8y$	$-442.0z$	$+168.3u$	$-101.8v$	$+31.0w$	=	$+20.0$
	$+1165.0$	$+117.8$	$+13.2$	$+84.3$	-277.0	=	-6.0
		$+1476.7$	-5.1	$+64.9$	-368.0	=	-23.1
			$+1267.6$	$+528.7$	$+153.8$	=	$+22.1$
				$+1254.3$	$+184.2$	=	-3.3
					$+1027.7$	=	$+37.6$
					$[nn]$	=	9.38

$x=+0.0138\pm0.0087$	$du=+0^\circ.40\pm0^\circ.25$
$y=+0.0089\pm0.0085$	$dN=+0^\circ.41\pm0^\circ.39$
$z=-0.0019\pm0.0078$	$dI=-0^\circ.09\pm0^\circ.36$
$u=+0.0171\pm0.0084$	$Q=126^\circ.6\pm16^\circ.0$
$v=-0.0148\pm0.0084$	$e=0.0074\pm0.0033$
$w=+0.0380\pm0.0093$	$da=+0''.279\pm0''.068$
$[vv]=7.26$	$r=0''.265$
$[nn.6]=7.26$	

Normal Equations and Solutions—Continued.

1892–93. LICK OBSERVATORY; BARNARD.

$+284.4x$	$-13.4y$	$-114.7z$	$+27.6u$	$-16.6v$	$+23.2w$	=	+6.5
	+287.0	−0.9	+11.4	−25.2	−78.7	=	+4.6
		+395.7	−54.7	+44.8	−78.4	=	+0.2
			+228.6	+76.3	+14.3	=	−0.1
				+245.6	+37.1	=	−1.7
					+219.3	=	+2.6
					[nn]	=	1.00

$x = +0.0272 \pm 0.0098$	$du = +0°.70 \pm 0°.25$
$y = +0.0231 \pm 0.0097$	$dN = +0°.93 \pm 0°.39$
$z = +0.0142 \pm 0.0090$	$dI = +0°.65 \pm 0°.41$
$u = +0.0004 \pm 0.0112$	$Q = 177°.4 \pm 72°.0$
$v = -0.0090 \pm 0.0110$	$e = 0.0022 \pm 0.0028$
$w = +0.0239 \pm 0.0117$	$da = +0''.130 \pm 0''.064$
$[vv] = 0.64$	$r = 0''.155$
$[nn.6] = 0.65$	

1893–94. LICK OBSERVATORY; BARNARD.

$+347.0x$	$+50.6y$	$-179.2z$	$-148.8u$	$-30.1v$	$+12.1w$	=	+2.8
	+346.0	−79.6	−49.0	+90.4	−52.1	=	+0.4
		+402.7	+41.7	−31.6	−60.9	=	−1.1
			+279.2	+50.2	−44.9	=	+3.4
				+264.9	−79.5	=	−0.8
					+213.4	=	−1.4
					[nn]	=	0.66

$x = +0.0178 \pm 0.0093$	$du = +0°.51 \pm 0°.26$
$y = +0.0038 \pm 0.0077$	$dN = +0°.17 \pm 0°.36$
$z = +0.0024 \pm 0.0080$	$dI = +0°.11 \pm 0°.37$
$u = +0.0227 \pm 0.0094$	$Q = 107°.0 \pm 19°.6$
$v = -0.0077 \pm 0.0091$	$e = 0.0065 \pm 0.0026$
$w = -0.0037 \pm 0.0102$	$da = -0''.018 \pm 0''.051$
$[vv] = 0.52$	$r = 0''.130$
$[nn.6] = 0.53$	

1894–95. LICK OBSERVATORY; BARNARD.

$+628.9x$	$-164.9y$	$-167.4z$	$+61.2u$	$+129.1v$	$+13.3w$	=	+0.4
	+573.8	+102.2	−9.5	−81.2	−146.2	=	+7.3
		+761.5	+99.6	−57.4	−266.7	=	+3.2
			+615.7	+232.6	−2.8	=	+4.9
				+696.7	−11.2	=	+1.9
					+547.0	=	−2.0
					[nn]	=	0.75

$x = +0.0042 \pm 0.0049$	$du = +0°.12 \pm 0°.14$
$y = +0.0141 \pm 0.0051$	$dN = +0°.65 \pm 0°.23$
$z = +0.0030 \pm 0.0048$	$dI = +0°.14 \pm 0°.22$
$u = +0.0067 \pm 0.0050$	$Q = 78°.2 \pm 35°.5$
$v = +0.0016 \pm 0.0047$	$e = 0.0025 \pm 0.0016$
$w = +0.0017 \pm 0.0055$	$da = +0''.013 \pm 0''.041$
$[vv] = 0.62$	$r = 0''.113$
$[nn.6] = 0.61$	

1894–95. LICK OBSERVATORY; SCHAEBERLE.

$+489.7x$	$-259.0y$	$-135.6z$	$+49.4u$	$-30.9v$	$-43.2w$	=	+5.4
	+616.9	+112.7	−18.4	+38.4	−58.6	=	−1.4
		+550.6	+6.2	+21.0	−244.6	=	+1.4
			+621.2	+182.1	+46.1	=	+0.8
				+410.3	+41.2	=	−8.0
					+447.4	=	−3.4
					[nn]	=	0.53

$x = +0.0119 \pm 0.0053$	$du = +0°.34 \pm 0°.15$
$y = +0.0033 \pm 0.0045$	$dN = +0°.19 \pm 0°.26$
$z = +0.0049 \pm 0.0051$	$dI = +0°.19 \pm 0°.21$
$u = +0.0073 \pm 0.0042$	$Q = 149°.5 \pm 13°.5$
$v = -0.0226 \pm 0.0052$	$e = 0.0065 \pm 0.0017$
$w = -0.0017 \pm 0.0056$	$da = -0''.013 \pm 0''.046$
$[vv] = 0.29$	$r = 0''.097$
$[nn.6] = 0.28$	

Normal Equations and Solutions—Continued.

1895–96. LICK OBSERVATORY; SCHAEBERLE.

+ 721.4x	− 215.8y	− 105.7z	+ 144.6u	− 352.1v	+ 26.9w	=	+12.8
	+ 700.0	+ 211.8	+ 212.4	+ 181.2	− 187.4	=	+ 2.3
		+ 762.8	− 279.0	+ 180.8	− 305.8	=	− 5.4
			+ 861.6	+ 302.9	+ 180.1	=	+ 6.5
				+ 755.5	+ 242.6	=	−10.4
					+ 559.6	=	− 3.0
					[nn]	=	0.64

$x=+0.0149\pm0.0047$	$du=+0°.43\pm0°.14$
$y=+0.0091\pm0.0039$	$dN=+0°.47\pm0°.20$
$z=-0.0057\pm0.0052$	$dI=-0°.26\pm0°.24$
$u=+0.0047\pm0.0048$	$Q=141°.6\pm19°.4$
$v=-0.0081\pm0.0062$	$e=0.0031\pm0.0025$
$w=-0.0043\pm0.0053$	$da=-0''.036\pm0''.042$
$[vv]=$ 0.27	$r=$ 0″.077
$[nn.6]=$ 0.27	

1896–97. LICK OBSERVATORY; SCHAEBERLE.

+ 205.9x	− 35.8y	− 33.9z	− 61.4u	+ 9.5v	+ 12.6w	=	+ 1.9
	+ 152.2	+ 35.7	− 20.1	+ 12.3	− 46.6	=	+ 2.9
		+ 287.0	+ 26.8	− 26.3	− 93.9	=	+ 2.3
			+ 160.6	+ 56.7	− 18.6	=	+ 0.8
				+ 202.3	− 56.4	=	+ 0.5
					+ 157.8	=	− 0.5
					[nn]	=	0.30

$x=+0.0193\pm0.0075$	$du=+0°.44\pm0°.17$
$y=+0.0264\pm0.0086$	$dN=+0°.91\pm0°.30$
$z=+0.0086\pm0.0067$	$dI=+0°.37\pm0°.29$
$u=+0.0157\pm0.0090$	$Q=91°.5\pm26°.2$
$v=-0.0004\pm0.0080$	$e=0.0039\pm0.0023$
$w=+0.0100\pm0.0096$	$da=+0''.054\pm0''.052$
$[vv]=$ 0.16	$r=$ 0″.096
$[nn.6]=$ 0.16	

1896–97. LOWELL OBSERVATORY; DREW.

+2126.2x	− 727.1y	− 442.0z	+ 25.1u	+ 404.0v	+ 9.5w	=	−11.8
	+2095.0	+ 376.4	− 129.6	− 302.3	− 433.0	=	+16.7
		+2386.0	+ 304.8	− 193.9	−1005.6	=	+21.7
			+2343.5	+ 637.8	− 101.8	=	+ 5.8
				+1688.1	− 62.0	=	−24.4
					+1910.8	=	−21.4
					[nn]	=	12.72

$x=-0.0009\pm0.0063$	$du=-0°.02\pm0°.18$
$y=+0.0054\pm0.0063$	$dN=+0°.18\pm0°.33$
$z=+0.0024\pm0.0063$	$dI=+0°.11\pm0°.29$
$u=+0.0063\pm0.0058$	$Q=148°.0\pm22°.8$
$v=-0.0161\pm0.0070$	$e=0.0047\pm0.0022$
$w=-0.0094\pm0.0070$	$da=-0''.077\pm0''.057$
$[vv]=$ 12.02	$r=$ 0″.261
$[nn.6]=$ 11.97	

1897–98. LICK OBSERVATORY; SCHAEBERLE.

+ 805.8x	− 341.3y	− 162.3z	+ 193.2u	+ 256.2v	− 30.3w	=	+14.7
	+ 905.2	+ 125.7	+ 25.3	− 235.9	− 92.7	=	− 0.2
		+ 998.6	+ 222.4	− 50.9	− 459.3	=	− 5.4
			+ 984.4	+ 187.5	− 31.2	=	+14.1
				+ 691.3	+ 40.7	=	+ 7.9
					+ 757.9	=	+ 7.2
					[nn]	=	0.91

$x=+0.0186\pm0.0036$	$du=+0°.53\pm0°.10$
$y=+0.0088\pm0.0034$	$dN=+0°.50\pm0°.18$
$z=-0.0002\pm0.0029$	$dI=-0°.01\pm0°.15$
$u=+0.0102\pm0.0033$	$Q=77°.7\pm11°.4$
$v=+0.0040\pm0.0031$	$e=0.0047\pm0.0013$
$w=+0.0114\pm0.0035$	$da=+0''.093\pm0''.029$
$[vv]=$ 0.38	$r=$ 0″.082
$[nn.6]=$ 0.37	

Normal Equations and Solutions—Continued.

1897–98. YERKES OBSERVATORY; BARNARD.

+1607.1*x*	− 526.9*y*	− 372.7*z*	− 85.4*u*	− 42.2*v*	− 70.5*w*	=	+11.6
	+1398.9	+ 146.5	+ 7.9	+ 28.9	− 99.4	=	+24.2
		+1759.5	− 49.4	− 9.2	− 694.4	=	+13.7
			+1455.8	+ 307.1	− 27.2	=	+11.4
				+1363.3	− 40.4	=	−17.4
					+1118.4	=	−19.4
					[*nn*]	=	6.16

x = +0.0152 ± 0.0041	*du* = +0°.35 ± 0°.09
y = +0.0219 ± 0.0042	*dN* = +0°.88 ± 0°.17
z = +0.0047 ± 0.0042	*dI* = +0°.16 ± 0°.14
u = +0.0119 ± 0.0040	*Q* = 131°.6 ± 10°.6
v = −0.0157 ± 0.0041	*e* = 0.0048 ± 0.0011
w = −0.0118 ± 0.0052	*da* = −0″.064 ± 0″.028
[*vv*] = 4.75	*r* = 0″.147
[*nn*.6] = 4.75	

1897–98. U. S. NAVAL OBSERVATORY; BROWN.

+1570.5*x*	− 488.7*y*	− 326.7*z*	+ 187.1*u*	+ 24.8*v*	− 33.1*w*	=	+26.9
	+1450.0	+ 190.5	+ 136.4	− 47.5	− 184.0	=	+ 2.2
		+1765.2	+ 13.0	+ 12.4	− 729.2	=	−11.5
			+1582.6	+ 377.1	+ 74.5	=	+13.0
				+1622.7	+ 134.7	=	+37.8
					+1257.2	=	0.0
					[*nn*]	=	4.46

x = +0.0181 ± 0.0038	*du* = +0°.46 ± 0°.10
y = +0.0087 ± 0.0039	*dN* = +0°.40 ± 0°.18
z = −0.0060 ± 0.0038	*dI* = −0°.24 ± 0°.15
u = −0.0001 ± 0.0036	*Q* = 0°.0 ± 12°.2
v = +0.0237 ± 0.0035	*e* = 0.0059 ± 0.0009
w = −0.0042 ± 0.0045	*da* = −0″.028 ± 0″.029
[*vv*] = 3.00	*r* = 0″.136
[*nn*.6] = 2.97	

1898–99. YERKES OBSERVATORY; BARNARD.

+1665.1*x*	− 549.4*y*	− 305.3*z*	− 108.9*u*	+ 136.8*v*	− 48.6*w*	=	+13.9
	+1411.0	+ 152.2	− 128.0	− 49.4	− 115.6	=	+ 0.8
		+1746.6	+ 159.9	− 57.4	− 728.5	=	+14.4
			+1455.2	+ 285.7	− 59.9	=	−17.2
				+1424.6	− 115.2	=	−17.3
					+1127.2	=	−18.1
					[*nn*]	=	4.05

x = +0.0095 ± 0.0033	*du* = +0°.22 ± 0°.07
y = +0.0013 ± 0.0035	*dN* = +0°.05 ± 0°.14
z = +0.0043 ± 0.0035	*dI* = +0°.15 ± 0°.12
u = −0.0098 ± 0.0033	*Q* = 230°.4 ± 13°.3
v = −0.0120 ± 0.0033	*e* = 0.0038 ± 0.0008
w = −0.0146 ± 0.0043	*da* = −0″.080 ± 0″.023
[*vv*] = 3.22	*r* = 0″.120
[*nn*.6] = 3.20	

1898–99. LICK OBSERVATORY; AITKEN.

+ 699.6*x*	− 382.8*y*	− 158.4*z*	+ 136.1*u*	+ 225.6*v*	− 85.9*w*	=	0.0
	+ 688.8	+ 43.3	− 4.2	− 209.6	+ 68.4	=	+17.3
		+ 738.9	+ 172.5	− 35.2	− 392.5	=	+ 0.2
			+ 820.2	+ 102.4	− 64.0	=	+19.2
				+ 640.3	+ 14.0	=	− 0.8
					+ 582.9	=	− 8.8
					[*nn*]	=	2.04

x = +0.0023 ± 0.0066	*du* = + 0°.07 ± 0°.19
y = +0.0324 ± 0.0060	*dN* = + 1°.86 ± 0°.34
z = −0.0235 ± 0.0067	*dI* = − 0°.94 ± 0°.27
u = +0.0253 ± 0.0048	*Q* = 85°.5 ± 6°.4
v = +0.0040 ± 0.0055	*e* = 0.0126 ± 0.0024
w = −0.0319 ± 0.0071	*da* = −0″.261 ± 0″.059
[*vv*] = 0.72	*r* = 0″.128
[*nn*.6] = 0.72	

Normal Equations and Solutions—Continued.

1898–99. Lick Observatory; Hussey.

+ 513.7x	+ 89.6y	− 121.5z	− 20.7u	+ 51.2v	+ 19.0w	=	+ 5.3
	+ 652.5	− 10.2	− 53.2	+ 11.3	− 91.0	=	+ 1.8
		+ 630.6	+ 96.7	− 17.0	− 177.7	=	− 4.9
			+ 633.6	+ 81.9	− 24.8	=	+ 1.5
				+ 526.0	− 64.5	=	+ 1.7
					+ 448.2	=	+ 5.6
					[nn]	=	1.60

x = +0.0083 ± 0.0085	du = + 0°.24 ± 0°.25
y = +0.0036 ± 0.0075	dN = + 0°.21 ± 0°.43
z = −0.0030 ± 0.0082	dI = − 0°.17 ± 0°.47
u = +0.0035 ± 0.0076	Q = 50°.2 ± 98°.5
v = +0.0034 ± 0.0083	e = 0.0016 ± 0.0024
w = +0.0122 ± 0.0096	da = + 0".080 ± 0".062
[vv] = 1.44	r = 0".186
[nn.6] = 1.46	

1898–99. Lowell Observatory; Drew.

+ 586.1x	− 182.9y	− 6.0z	− 15.3u	+ 138.7v	+ 57.8w	=	+12.4
	+ 568.1	+ 147.9	− 127.8	− 104.1	− 204.3	=	− 0.6
		+ 600.9	+ 96.0	− 7.4	− 309.2	=	− 6.7
			+ 644.6	+ 188.8	− 77.0	=	− 0.6
				+ 473.8	− 47.0	=	+ 9.1
					+ 558.8	=	+11.2
					[nn]	=	1.86

x = +0.0200 ± 0.0078	du = +0°.57 ± 0°.22
y = +0.0192 ± 0.0085	dN = +0°.99 ± 0°.44
z = −0.0024 ± 0.0084	dI = −0°.11 ± 0°.38
u = +0.0010 ± 0.0076	Q = 4°.6 ± 35°.3
v = +0.0199 ± 0.0088	e = 0.0050 ± 0.0021
w = +0.0255 ± 0.0090	da = +0".209 ± 0".073
[vv] = 1.14	r = 0".170
[nn.6] = 1.14	

1898–99. Pulkowa Observatory; Photographs.

+ 209.8x	− 76.6y	− 48.1z	− 11.6u	− 36.6v	− 12.5w	=	+ 8.5
	+ 232.2	+ 17.8	− 26.8	+ 37.2	− 12.3	=	− 0.5
		+ 227.3	− 21.3	+ 14.7	− 109.6	=	+ 6.2
			+ 326.5	+ 52.9	+ 5.6	=	− 3.7
				+ 282.6	+ 2.4	=	− 2.7
					+ 210.5	=	− 8.0
					[nn]	=	1.14

x = +0.0481 ± 0.0115	du = +1°.10 ± 0°.26
y = +0.0107 ± 0.0105	dN = +0°.49 ± 0°.48
z = +0.0263 ± 0.0119	dI = +0°.90 ± 0°.41
u = −0.0052 ± 0.0084	Q = 240°.2 ± 67°.0
v = −0.0047 ± 0.0091	e = 0.0024 ± 0.0029
w = −0.0201 ± 0.0120	da = −0".130 ± 0".078
[vv] = 0.38	r = 0".147
[nn.6] = 0.39	

1899–1900. Lick Observatory; Hussey.

+ 357.0x	− 19.5y	+ 11.2z	− 65.0u	+ 30.8v	+ 48.1w	=	+ 1.9
	+ 374.1	+ 103.5	− 96.8	− 16.6	− 134.5	=	− 8.2
		+ 439.9	+ 12.8	+ 2.8	− 148.6	=	− 6.7
			+ 396.8	+ 117.6	− 33.0	=	+ 2.6
				+ 378.4	− 59.7	=	+ 2.3
					+ 276.5	=	+14.8
					[nn]	=	1.24

x = −0.0030 ± 0.0071	du = − 0°.09 ± 0°.20
y = +0.0009 ± 0.0077	dN = + 0°.05 ± 0°.40
z = +0.0049 ± 0.0068	dI = + 0°.28 ± 0°.39
u = +0.0070 ± 0.0072	Q = 30°.3 ± 32°.1
v = +0.0138 ± 0.0071	e = 0.0048 ± 0.0019
w = +0.0608 ± 0.0095	da = + 0".396 ± 0".062
[vv] = 0.36	r = 0".127
[nn.6] = 0.33	

Normal Equations and Solutions—Continued.

1899–1900. PULKOWA OBSERVATORY; PHOTOGRAPHS.

$+304.6x$	$-16.4y$	$+20.2z$	$-1.8u$	$+62.8v$	$+46.8w$	=	-0.8
	$+256.4$	$+88.4$	-12.3	-39.6	-113.2	=	$+0.4$
		$+366.9$	$+50.9$	-24.6	-125.8	=	$+7.6$
			$+335.0$	$+116.8$	-9.1	=	-4.9
				$+323.0$	-18.7	=	$+3.1$
					$+233.1$	=	-6.6
					$[nn]$	=	0.77

$x=-0.0057\pm0.0078$	$du=-0^\circ.16\pm0^\circ.22$
$y=-0.0144\pm0.0093$	$dN=-0^\circ.66\pm0^\circ.42$
$z=+0.0219\pm0.0078$	$dI=+1^\circ.25\pm0^\circ.45$
$u=-0.0261\pm0.0077$	$Q=302^\circ.5\pm10^\circ.7$
$v=+0.0192\pm0.0082$	$e=0.0108\pm0.0030$
$w=-0.0221\pm0.0107$	$da=-0''.143\pm0''.070$
$[vv]=0.29$	$r=0''.128$
$[nn.6]=0.27$	

1899–1900. YERKES OBSERVATORY; BARNARD.

$+3260.6x$	$-720.9y$	$-388.8z$	$-39.4u$	$-309.6v$	$+28.7w$	=	$+57.5$
	$+2902.4$	$+317.3$	$+289.4$	$+179.1$	-358.6	=	$+4.4$
		$+3370.0$	-324.6	-44.8	-1311.6	=	$+16.5$
			$+3667.5$	$+547.6$	$+96.9$	=	-28.8
				$+2699.3$	$+50.1$	=	-31.1
					$+2228.6$	=	-14.6
					$[nn]$	=	5.85

$x=+0.0189\pm0.0021$	$du=+0^\circ.54\pm0^\circ.06$
$y=+0.0071\pm0.0023$	$dN=+0^\circ.37\pm0^\circ.11$
$z=+0.0047\pm0.0023$	$dI=+0^\circ.22\pm0^\circ.11$
$u=-0.0064\pm0.0020$	$Q=231^\circ.1\pm12^\circ.7$
$v=-0.0084\pm0.0023$	$e=0.0033\pm0.0007$
$w=-0.0025\pm0.0029$	$da=-0''.016\pm0''.018$
$[vv]=4.17$	$r=0''.118$
$[nn.6]=4.19$	

1899–1900. U. S. NAVAL OBSERVATORY; SEE.

$+3104.2x$	$-731.7y$	$-491.3z$	$+6.2u$	$-591.5v$	$-78.0w$	=	$+61.7$
	$+2171.9$	$+150.0$	$+203.1$	$+370.7$	-139.8	=	$+9.9$
		$+3039.8$	-462.7	$+101.2$	-1265.5	=	-44.7
			$+2887.9$	$+402.8$	$+152.0$	=	$+3.2$
				$+2646.5$	$+162.8$	=	$+31.9$
					$+2111.7$	=	$+72.4$
					$[nn]$	=	17.34

$x=+0.0274\pm0.0042$	$du=+0^\circ.78\pm0^\circ.12$
$y=+0.0139\pm0.0049$	$dN=+0^\circ.64\pm0^\circ.22$
$z=+0.0037\pm0.0047$	$dI=+0^\circ.16\pm0^\circ.20$
$u=-0.0033\pm0.0041$	$Q=341^\circ.6\pm21^\circ.9$
$v=+0.0143\pm0.0044$	$e=0.0038\pm0.0012$
$w=+0.0375\pm0.0055$	$da=+0''.244\pm0''.036$
$[vv]=12.53$	$r=0''.215$
$[nn.6]=12.52$	

1900–01. YERKES OBSERVATORY; BARNARD.

$+2439.5x$	$-833.9y$	$-150.1z$	$+167.5u$	$+176.7v$	$+44.6w$	=	$+9.2$
	$+2086.0$	$+303.0$	$+25.2$	-123.1	-315.5	=	$+7.0$
		$+2697.4$	$+174.7$	-0.5	-1252.1	=	$+7.4$
			$+2349.7$	$+419.0$	-4.9	=	-43.5
				$+2090.3$	$+77.7$	=	-28.5
					$+1841.2$	=	-4.7
					$[nn]$	=	4.74

$x=+0.0080\pm0.0029$	$du=+0^\circ.23\pm0^\circ.08$
$y=+0.0057\pm0.0032$	$dN=+0^\circ.29\pm0^\circ.17$
$z=+0.0045\pm0.0031$	$dI=+0^\circ.21\pm0^\circ.14$
$u=-0.0177\pm0.0028$	$Q=249^\circ.9\pm6^\circ.5$
$v=-0.0105\pm0.0030$	$e=0.0076\pm0.0010$
$w=+0.0016\pm0.0038$	$da=+0''.011\pm0''.028$
$[vv]=3.56$	$r=0''.134$
$[nn.6]=3.54$	

Normal Equations and Solutions—Continued.

1900–01. Pulkowa Observatory; Photographs.

$+304.6x$	$-216.7y$	$-10.9z$	$-134.4u$	$+61.1v$	$-1.3w$	=	$+8.5$
	$+301.1$	$+60.3$	-10.8	-41.9	-48.1	=	$+3.9$
		$+229.1$	$+49.5$	-31.5	-157.6	=	$+11.7$
			$+304.4$	$+94.7$	-48.7	=	-0.9
				$+275.4$	-88.4	=	$+17.2$
					$+187.0$	=	-17.6
					$[nn]$	=	2.62

$x=+0.0411\pm0.0300$	$du=+1^\circ.18\pm0^\circ.86$
$y=+0.0375\pm0.0235$	$dN=+2^\circ.15\pm1^\circ.35$
$z=+0.0204\pm0.0331$	$dI=+0^\circ.70\pm1^\circ.14$
$u=-0.0092\pm0.0231$	$Q=339^\circ.6\pm39^\circ.9$
$v=+0.0496\pm0.0247$	$e=0.0132\pm0.0094$
$w=-0.0461\pm0.0328$	$da=-0''.375\pm0''.267$
$[vv]=0.20$	$r=0''.153$
$[nn.6]=0.21$	

1901–02. Yerkes Observatory; Barnard.

$+2220.3x$	$-460.7y$	$-213.6z$	$-203.8u$	$-50.1v$	$-2.7w$	=	$+29.3$
	$+1894.6$	$+96.2$	-151.6	$+71.5$	-130.4	=	$+19.2$
		$+2258.8$	$+7.4$	-4.3	-929.6	=	$+13.4$
			$+2460.2$	$+192.4$	-4.9	=	-16.0
				$+1855.0$	-108.8	=	-36.8
					$+1525.8$	=	$+5.2$
					$[nn]$	=	4.79

$x=+0.0166\pm0.0028$	$du=+0^\circ.48\pm0^\circ.08$
$y=+0.0148\pm0.0030$	$dN=+0^\circ.76\pm0^\circ.15$
$z=+0.0109\pm0.0031$	$dI=+0^\circ.50\pm0^\circ.14$
$u=-0.0028\pm0.0026$	$Q=192^\circ.9\pm12^\circ.1$
$v=-0.0190\pm0.0030$	$e=0.0049\pm0.0007$
$w=+0.0099\pm0.0038$	$da=+0''.065\pm0''.024$
$[vv]=3.09$	$r=0''.126$
$[nn.6]=3.06$	

1901–02. Lick Observatory; Photographs.

$+750.8x$	$-110.0y$	$-65.2z$	$+194.3u$	$+129.4v$	$+7.2w$	=	$+5.5$
	$+812.5$	$+37.2$	$+107.1$	-128.3	-69.3	=	$+10.3$
		$+630.6$	$+76.0$	$+7.2$	-276.1	=	-2.2
			$+811.5$	$+79.4$	-1.8	=	-19.1
				$+607.0$	$+103.5$	=	$+4.7$
					$+553.5$	=	-7.2
					$[nn]$	=	1.50

$x=+0.0150\pm0.0053$	$du=+0^\circ.43\pm0^\circ.15$
$y=+0.0200\pm0.0050$	$dN=+1^\circ.15\pm0^\circ.29$
$z=-0.0072\pm0.0063$	$dI=-0^\circ.31\pm0^\circ.27$
$u=-0.0308\pm0.0051$	$Q=289^\circ.0\pm6^\circ.9$
$v=+0.0160\pm0.0058$	$e=0.0123\pm0.0019$
$w=-0.0174\pm0.0067$	$da=-0''.114\pm0''.044$
$[vv]=0.41$	$r=0''.136$
$[nn.6]=0.42$	

1901–02. Lick Observatory; Aitken.

$+598.9x$	$-124.2y$	$-151.9z$	$-62.3u$	$-133.3v$	$-62.5w$	=	$+20.5$
	$+597.7$	-93.7	-100.4	$+137.8$	$+115.4$	=	-5.5
		$+634.8$	-62.3	$+20.9$	-253.3	=	-9.6
			$+639.1$	-59.6	$+35.1$	=	$+5.5$
				$+516.6$	-27.5	=	-15.2
					$+428.7$	=	-2.8
					$[nn]$	=	1.83

$x=+0.0266\pm0.0062$	$du=+0^\circ.76\pm0^\circ.18$
$y=+0.0038\pm0.0059$	$dN=+0^\circ.22\pm0^\circ.34$
$z=-0.0119\pm0.0065$	$dI=-0^\circ.55\pm0^\circ.30$
$u=+0.0092\pm0.0054$	$Q=147^\circ.0\pm17^\circ.5$
$v=-0.0227\pm0.0062$	$e=0.0068\pm0.0017$
$w=-0.0128\pm0.0077$	$da=-0''.083\pm0''.051$
$[vv]=0.75$	$r=0''.131$
$[nn.6]=0.76$	

Normal Equations and Solutions—Continued.

1902–03. Strasburg Observatory; Wirtz.

$+466.4x$	$-97.7y$	$-35.9z$	$-32.8u$	$-15.7v$	$+1.1w$	=	-15.7
	$+486.9$	$+22.2$	-19.6	$+41.2$	-30.1	=	-1.4
		$+463.6$	$+37.1$	-6.5	-193.6	=	$+4.6$
			$+530.2$	$+44.6$	$+16.8$	=	-25.7
				$+386.2$	-19.4	=	-8.8
					$+324.0$	=	-4.3
					$[nn]$	=	5.70

$x=-0.0398\pm0.0162$	$du=-1.^\circ14\pm0.^\circ46$
$y=-0.0123\pm0.0158$	$dN=-0.^\circ70\pm0.^\circ91$
$z=+0.0079\pm0.0184$	$dI=+0.^\circ36\pm0.^\circ84$
$u=-0.0503\pm0.0150$	$Q=257.^\circ7\pm12.^\circ8$
$v=-0.0174\pm0.0175$	$e=0.0206\pm0.0058$
$w=-0.0080\pm0.0220$	$da=-0.''052\pm0.''143$
$[vv]=3.54$	$r=0.''339$
$[nn.6]=3.53$	

1902–03. Yerkes Observatory; Barnard.

$+1429.1x$	$-566.5y$	$-8.6z$	$-57.7u$	$-110.8v$	$+62.2w$	=	$+21.2$
	$+1381.9$	$+185.8$	$+102.9$	$+98.9$	-238.9	=	$+8.2$
		$+1598.0$	-105.7	-21.6	-829.8	=	-2.7
			$+1651.5$	$+203.1$	$+43.6$	=	-17.2
				$+1227.9$	$+23.3$	=	-22.1
					$+1231.8$	=	$+6.2$
					$[nn]$	=	2.66

$x=+0.0196\pm0.0034$	$du=+0.^\circ56\pm0.^\circ10$
$y=+0.0172\pm0.0036$	$dN=+0.^\circ99\pm0.^\circ20$
$z=-0.0003\pm0.0037$	$dI=-0.^\circ01\pm0.^\circ17$
$u=-0.0090\pm0.0030$	$Q=224.^\circ3\pm12.^\circ0$
$v=-0.0163\pm0.0034$	$e=0.0057\pm0.0010$
$w=+0.0079\pm0.0042$	$da=+0.''065\pm0.''034$
$[vv]=1.53$	$r=0.''119$
$[nn.6]=1.54$	

1902–03. U. S. Naval Observatory; Dinwiddie.

$+778.6x$	$-15.7y$	$-54.4z$	$+34.7u$	$+145.1v$	$+8.2w$	=	$+17.4$
	$+664.7$	$+9.4$	$+23.4$	-98.0	-41.2	=	-0.7
		$+826.0$	$+126.4$	-19.3	-288.2	=	$+13.2$
			$+885.1$	$+40.4$	-14.6	=	$+40.3$
				$+766.7$	$+9.2$	=	$+16.7$
					$+538.6$	=	-1.2
					$[nn]$	=	5.57

$x=+0.0181\pm0.0071$	$du=+0.^\circ47\pm0.^\circ18$
$y=+0.0004\pm0.0076$	$dN=+0.^\circ02\pm0.^\circ35$
$z=+0.0129\pm0.0076$	$dI=+0.^\circ59\pm0.^\circ35$
$u=+0.0422\pm0.0066$	$Q=73.^\circ8\pm7.^\circ2$
$v=+0.0164\pm0.0072$	$e=0.0147\pm0.0021$
$w=+0.0051\pm0.0092$	$da=+0.''028\pm0.''051$
$[vv]=3.10$	$r=0.''193$
$[nn.6]=3.12$	

1903–04. Yerkes Observatory; Barnard.

$+1202.3x$	$-500.7y$	$-28.9z$	$-17.5u$	$+50.2v$	$-7.3w$	=	$+14.8$
	$+1144.3$	$+22.1$	$+28.9$	-12.8	-17.0	=	-1.0
		$+1040.2$	$+89.0$	-12.6	-635.0	=	$+4.4$
			$+1344.5$	$+39.1$	$+3.9$	=	-11.3
				$+1053.2$	-12.8	=	-23.5
					$+1065.2$	=	$+0.3$
					$[nn]$	=	2.86

$x=+0.0158\pm0.0048$	$du=+0.^\circ45\pm0.^\circ14$
$y=+0.0060\pm0.0049$	$dN=+0.^\circ34\pm0.^\circ28$
$z=+0.0080\pm0.0059$	$dI=+0.^\circ32\pm0.^\circ24$
$u=-0.0082\pm0.0041$	$Q=213.^\circ5\pm14.^\circ5$
$v=-0.0224\pm0.0046$	$e=0.0067\pm0.0014$
$w=+0.0050\pm0.0058$	$da=+0.''041\pm0.''047$
$[vv]=1.98$	$r=0.''150$
$[nn.6]=1.98$	

Normal Equations and Solutions—Continued.

1904–05. Yerkes Observatory; Barnard.

+ 730.8x	− 162.5y	+ 45.2z	− 69.6u	+ 84.2v	+ 20.5w	=	+14.9
	+ 722.5	+ 36.3	− 13.5	− 84.3	− 43.1	=	− 0.5
		+ 713.7	+ 39.5	− 12.7	− 309.0	=	− 6.6
			+ 808.1	+ 32.2	− 26.2	=	−12.1
				+ 608.3	− 36.6	=	− 7.9
					+ 495.3	=	+11.2
					[nn]	=	1.75

x = +0.0212 ± 0.0052	du = +0°.61 ± 0°.15
y = +0.0035 ± 0.0052	dN = +0°.20 ± 0°.30
z = −0.0019 ± 0.0060	dI = −0°.09 ± 0°.27
u = −0.0119 ± 0.0048	Q = 234°.7 ± 15°.9
v = −0.0136 ± 0.0056	e = 0.0059 ± 0.0017
w = +0.0195 ± 0.0072	da = +0″.127 ± 0″.047
[vv] = 0.96	r = 0″.135
[nn.6] = 0.96	

1904–05. U. S. Naval Observatory; Hammond.

+ 527.7x	− 98.8y	− 137.6z	− 147.9u	+ 65.6v	− 78.9w	=	+11.2
	+ 523.8	− 155.3	− 108.4	− 40.0	+ 192.0	=	+ 1.3
		+ 644.3	+ 94.6	− 24.2	− 272.8	=	− 7.0
			+ 764.3	− 141.0	− 11.0	=	+ 1.0
				+ 435.9	− 89.2	=	+ 5.3
					+ 468.0	=	− 2.6
					[nn]	=	1.75

x = +0.0208 ± 0.0098	du = +0°.60 ± 0°.28
y = +0.0098 ± 0.0098	dN = +0°.56 ± 0°.56
z = −0.0088 ± 0.0098	dI = −0°.45 ± 0°.51
u = +0.0096 ± 0.0077	Q = 58°.8 ± 28°.1
v = +0.0106 ± 0.0100	e = 0.0050 ± 0.0035
w = −0.0088 ± 0.0117	da = −0″.065 ± 0″.086
[vv] = 1.36	r = 0″.196
[nn.6] = 1.35	

1904–05. U. S. Naval Observatory; Rice.

+ 308.7x	− 104.6y	− 7.7z	+ 138.7u	+ 24.2v	− 3.0w	=	+ 7.0
	+ 296.3	+ 0.9	+ 120.4	− 38.2	+ 2.2	=	+ 0.8
		+ 329.2	− 14.5	+ 8.2	− 177.1	=	− 7.2
			+ 378.3	+ 6.3	− 19.4	=	+ 7.1
				+ 264.8	+ 88.6	=	− 1.0
					+ 293.3	=	+ 10.3
					[nn]	=	0.91

x = +0.0180 ± 0.0099	du = +0°.52 ± 0°.28
y = +0.0001 ± 0.0101	dN = +0°.01 ± 0°.58
z = +0.0035 ± 0.0092	dI = +0°.16 ± 0°.42
u = +0.0149 ± 0.0091	Q = 127°.3 ± 19°.6
v = −0.0205 ± 0.0089	e = 0.0084 ± 0.0037
w = +0.0450 ± 0.0103	da = +0″.367 ± 0″.083
[vv] = 0.22	r = 0″.130
[nn.6] = 0.23	

1905–06. Yerkes Observatory; Barnard.

+ 572.3x	− 203.3y	+ 87.5z	− 90.8u	+ 60.3v	+ 51.4w	=	+ 9.4
	+ 532.2	+ 75.2	− 5.8	− 57.2	− 111.7	=	+ 9.4
		+ 546.0	+ 27.2	− 17.4	− 312.0	=	− 0.1
			+ 686.4	+ 76.3	− 26.9	=	+ 7.9
				+ 476.7	− 90.4	=	−10.3
					+ 464.5	=	+11.2
					[nn]	=	2.20

x = +0.0288 ± 0.0083	du = +0°.83 ± 0°.24
y = +0.0324 ± 0.0082	dN = +1°.86 ± 0°.47
z = +0.0071 ± 0.0101	dI = +0°.30 ± 0°.43
u = +0.0186 ± 0.0067	Q = 118°.7 ± 12°.8
v = −0.0183 ± 0.0084	e = 0.0096 ± 0.0030
w = +0.0312 ± 0.0110	da = +0″.254 ± 0″.090
[vv] = 0.95	r = 0″.170
[nn.6] = 0.94	

Normal Equations and Solutions—Continued.

1905–06. U. S. Naval Observatory; Hammond.

$+892.8x$	$-95.0y$	$+63.3z$	$-200.0u$	$+118.5v$	$+21.8w$	=	$+36.4$
	$+787.1$	$+34.3$	-101.3	-62.8	-37.2	=	$+18.5$
		$+1110.7$	$+172.7$	-32.4	-427.8	=	$+1.4$
			$+1284.8$	$+18.5$	-0.4	=	-19.2
				$+926.2$	-119.4	=	$+21.1$
					$+716.3$	=	-11.1
					$[nn]$	=	4.45

$x=+0.0412\pm0.0043$	$du=+0^\circ.94\pm0^\circ.10$
$y=+0.0287\pm0.0045$	$dN=+1^\circ.23\pm0^\circ.19$
$z=-0.0071\pm0.0043$	$dI=-0^\circ.30\pm0^\circ.19$
$u=-0.0056\pm0.0036$	$Q=332^\circ.9\pm15^\circ.3$
$v=+0.0172\pm0.0042$	$e=0.0044\pm0.0010$
$w=-0.0167\pm0.0054$	$da=-0''.091\pm0''.029$
$[vv]=1.79$	$r=0''.123$
$[nn.6]=1.77$	

1906–07. Yerkes Observatory; Barnard.

$+816.3x$	$-171.0y$	$+71.4z$	$+30.5u$	$-136.4v$	$-1.5w$	=	$+18.0$
	$+777.6$	-2.6	-21.6	$+53.4$	$+38.5$	=	$+9.7$
		$+1007.9$	-203.6	-13.0	-476.2	=	$+6.3$
			$+1138.8$	-24.6	$+2.6$	=	$+5.8$
				$+959.2$	$+47.3$	=	-5.7
					$+804.4$	=	-4.3
					$[nn]$	=	1.28

$x=+0.0250\pm0.0036$	$du=+0^\circ.72\pm0^\circ.10$
$y=+0.0185\pm0.0036$	$dN=+1^\circ.06\pm0^\circ.21$
$z=+0.0036\pm0.0038$	$dI=+0^\circ.19\pm0^\circ.19$
$u=+0.0053\pm0.0030$	$Q=110^\circ.6\pm22^\circ.5$
$v=-0.0031\pm0.0032$	$e=0.0026\pm0.0013$
$w=-0.0041\pm0.0041$	$da=-0''.033\pm0''.034$
$[vv]=0.57$	$r=0''.098$
$[nn.6]=0.55$	

1907–08. U. S. Naval Observatory; Hammond.

$+348.6x$	$+46.3y$	$+67.4z$	$-111.8u$	$-62.1v$	$+6.7w$	=	$+16.6$
	$+256.3$	$+25.8$	-61.5	$+17.6$	-1.2	=	$+8.7$
		$+392.9$	-88.0	-34.3	-124.6	=	$+7.3$
			$+324.8$	-2.1	$+12.4$	=	-8.5
				$+263.3$	-81.0	=	-2.3
					$+275.1$	=	$+5.0$
					$[nn]$	=	1.88

$x=+0.0409\pm0.0074$	$du=+0^\circ.94\pm0^\circ.17$
$y=+0.0232\pm0.0081$	$dN=+0^\circ.89\pm0^\circ.31$
$z=+0.0198\pm0.0074$	$dI=+0^\circ.91\pm0^\circ.34$
$u=-0.0033\pm0.0077$	$Q=339^\circ.1\pm51^\circ.1$
$v=+0.0106\pm0.0086$	$e=0.0022\pm0.0017$
$w=+0.0298\pm0.0089$	$da=+0''.145\pm0''.044$
$[vv]=0.70$	$r=0''.126$
$[nn.6]=0.69$	

1907–08. Yerkes Observatory; Barnard.

$+1263.5x$	$-449.7y$	$+235.0z$	$-181.1u$	$+64.2v$	$+95.8w$	=	$+16.6$
	$+1154.2$	$+49.8$	-43.3	-82.1	-129.0	=	$+8.2$
		$+1399.0$	$+10.4$	-41.2	-667.6	=	$+7.8$
			$+1484.6$	$+13.6$	-8.0	=	-8.1
				$+1102.7$	-102.5	=	-25.2
					$+964.2$	=	$+6.5$
					$[nn]$	=	2.39

$x=+0.0166\pm0.0038$	$du=+0^\circ.48\pm0^\circ.11$
$y=+0.0126\pm0.0038$	$dN=+0^\circ.72\pm0^\circ.22$
$z=+0.0057\pm0.0041$	$dI=+0^\circ.26\pm0^\circ.19$
$u=-0.0028\pm0.0031$	$Q=193^\circ.5\pm14^\circ.1$
$v=-0.0218\pm0.0036$	$e=0.0056\pm0.0009$
$w=+0.0083\pm0.0048$	$da=+0''.060\pm0''.036$
$[vv]=1.34$	$r=0''.118$
$[nn.6]=1.34$	

Normal Equations and Solutions—Continued.

1908–09. YERKES OBSERVATORY; BARNARD.

$+1372.4x$	$-389.1y$	$+87.4z$	$+287.3u$	$-38.6v$	$-17.3w$	=	-5.0
	$+1096.5$	-140.8	$+174.0$	$+40.9$	$+141.1$	=	$+6.9$
		$+1399.5$	-41.4	$+17.2$	-608.3	=	-13.1
			$+1429.0$	-200.2	-44.6	=	-10.3
				$+1145.2$	$+149.8$	=	-25.1
					$+847.0$	=	$+4.9$
					[nn]	=	3.28

$x=+0.0010\pm0.0045$	$du=+0.^\circ03\pm0.^\circ13$
$y=+0.0082\pm0.0050$	$dN=+0.^\circ42\pm0.^\circ26$
$z=-0.0076\pm0.0049$	$dI=-0.^\circ35\pm0.^\circ22$
$u=-0.0120\pm0.0042$	$Q=218.^\circ2\pm10.^\circ4$
$v=-0.0245\pm0.0046$	$e=0.0078\pm0.0015$
$w=+0.0025\pm0.0064$	$da=+0.''016\pm0.''042$
$[vv]=2.38$	$r=0.''150$
$[nn.6]=2.38$	

1908–09. U. S. NAVAL OBSERVATORY; A. HALL, JR.

$+1218.5x$	$-46.5y$	$+104.7z$	$+249.3u$	$+105.8v$	$-63.6w$	=	$+17.7$
	$+997.8$	-82.6	$+66.9$	-0.5	$+223.4$	=	$+19.8$
		$+1025.8$	$+159.4$	$+89.3$	-527.6	=	-20.2
			$+1439.5$	-134.3	-36.6	=	$+9.4$
				$+916.8$	$+125.3$	=	-4.3
					$+1354.0$	=	$+48.6$
					[nn]	=	7.00

$x=+0.0173\pm0.0063$	$du=+0.^\circ50\pm0.^\circ18$
$y=+0.0125\pm0.0069$	$dN=+0.^\circ64\pm0.^\circ36$
$z=-0.0019\pm0.0076$	$dI=-0.^\circ09\pm0.^\circ35$
$u=+0.0031\pm0.0059$	$Q=156.^\circ0\pm43.^\circ1$
$v=-0.0108\pm0.0073$	$e=0.0030\pm0.0018$
$w=+0.0350\pm0.0067$	$da=+0.''285\pm0.''055$
$[vv]=4.61$	$r=0.''214$
$[nn.6]=4.63$	

1909–10. YERKES OBSERVATORY; BARNARD.

$+1173.1x$	$-157.8y$	$+140.8z$	$-14.2u$	$-19.5v$	$-15.2w$	=	$+9.8$
	$+980.0$	-74.3	-60.5	-17.6	$+130.9$	=	-12.8
		$+1072.2$	-72.6	-0.7	-454.9	=	$+1.8$
			$+1284.0$	-155.7	-11.7	=	-4.9
				$+930.8$	-16.9	=	-29.8
					$+840.6$	=	$+1.4$
					[nn]	=	4.01

$x=+0.0058\pm0.0050$	$du=+0.^\circ17\pm0.^\circ14$
$y=-0.0137\pm0.0055$	$dN=-0.^\circ71\pm0.^\circ28$
$z=+0.0008\pm0.0059$	$dI=+0.^\circ04\pm0.^\circ27$
$u=-0.0083\pm0.0048$	$Q=200.^\circ3\pm10.^\circ7$
$v=-0.0334\pm0.0056$	$e=0.0090\pm0.0015$
$w=+0.0035\pm0.0067$	$da=+0.''023\pm0.''044$
$[vv]=2.73$	$r=0.''168$
$[nn.6]=2.74$	

1909–10. U. S. NAVAL OBSERVATORY; A. HALL, JR.

$+1644.6x$	$-77.8y$	$+46.8z$	$-674.6u$	$+635.2v$	$-86.1w$	=	-9.2
	$+1373.7$	-223.4	-265.3	-550.3	$+302.1$	=	-12.8
		$+1271.9$	$+345.6$	-64.2	-534.4	=	-19.9
			$+1942.0$	-366.7	-53.1	=	$+19.9$
				$+1744.1$	-263.3	=	$+33.2$
					$+1103.6$	=	$+8.8$
					[nn]	=	7.03

$x=-0.0086\pm0.0057$	$du=-0.^\circ25\pm0.^\circ16$
$y=-0.0007\pm0.0061$	$dN=-0.^\circ04\pm0.^\circ31$
$z=-0.0153\pm0.0066$	$dI=-0.^\circ70\pm0.^\circ30$
$u=+0.0149\pm0.0052$	$Q=36.^\circ0\pm10.^\circ7$
$v=+0.0256\pm0.0057$	$e=0.0095\pm0.0019$
$w=+0.0070\pm0.0070$	$da=+0.''046\pm0.''046$
$[vv]=5.44$	$r=0.''200$
$[nn.6]=5.43$	

Normal Equations and Solutions—Continued.

1910–11. Yerkes Observatory; Barnard.

+1285.1x	− 467.0y	+ 217.6z	+ 129.1u	+ 261.1v	+ 43.2w	=	+ 5.2
	+ 997.6	− 145.0	+ 176.5	− 170.3	+ 76.0	=	−20.5
		+1288.0	+ 187.0	+ 70.9	− 565.6	=	−38.0
			+1224.9	− 212.3	− 134.6	=	−21.3
				+1099.2	+ 126.5	=	−11.6
					+ 748.3	=	+23.1
					[nn]	=	5.18

x=+0.0031±0.0057	du=+0°.09 ± 0°.16
y=−0.0246±0.0063	dN=−1°.27 ± 0°.33
z=−0.0226±0.0062	dI=−0°.97 ± 0°.27
u=−0.0120±0.0053	Q=226°.9 ±14°.0
v=−0.0179±0.0056	e=0.0066 ±0.0020
w=+0.0170±0.0081	da=+0″.111±0″.054
[vv]= 2.94	r= 0″.174
[$nn.6$]= 2.94	

1910–11. U. S. Naval Observatory; A. Hall, Jr.

+ 767.9x	+ 103.4y	+ 294.8z	− 96.5u	+ 90.6v	+ 48.8w	=	+ 1.4
	+ 531.9	+ 113.8	+ 9.2	− 77.3	− 60.5	=	− 7.0
		+ 665.4	+ 62.3	− 57.0	− 199.5	=	− 8.4
			+ 618.2	+ 61.4	− 26.5	=	+ 5.8
				+ 573.2	+ 24.6	=	− 0.4
					+ 600.1	=	+10.7
					[nn]	=	1.45

x=+0.0105±0.0055	du=+0°.30 ± 0°.16
y=−0.0123±0.0058	dN=−0°.63 ± 0°.30
z=−0.0135±0.0061	dI=−0°.62 ± 0°.28
u=+0.0139±0.0053	Q=114°.3 ±16°.7
v=−0.0075±0.0056	e=0.0046 ±0.0017
w=+0.0123±0.0057	da=+0″.080±0″.037
[vv]= 1.04	r= 0″.128
[$nn.6$]= 1.00	

1910–11. U. S. Naval Observatory; Burton.

+ 885.0x	− 27.7y	+ 193.5z	+ 21.0u	− 52.0v	− 19.7w	=	+ 7.2
	+ 733.9	− 61.1	+ 81.1	+ 39.7	+ 113.0	=	−13.0
		+ 923.4	− 12.6	− 59.4	− 317.9	=	+ 4.2
			+1059.2	− 79.4	− 12.0	=	+20.8
				+ 676.1	+ 26.3	=	+ 7.1
					+ 669.8	=	+ 1.2
					[nn]	=	2.72

x=+0.0067±0.0054	du=+0°.19 ±0°.15
y=−0.0217±0.0059	dN=−1°.12 ±0°.30
z=+0.0058±0.0058	dI=+0°.30 ±0°.30
u=+0.0224±0.0048	Q= 65°.7 ±9°.3
v=+0.0151±0.0061	e=0.0092 ±0.0018
w=+0.0084±0.0067	da=+0″.055±0″.044
[vv]= 1.77	r= 0″.156
[$nn.6$]= 1.79	

1911–12. Yerkes Observatory; Barnard.

+ 899.8x	− 257.6y	+ 124.4z	− 5.7u	− 197.0v	− 7.5w	=	+ 8.0
	+ 746.2	− 142.0	− 84.7	+ 111.7	+ 136.4	=	− 1.8
		+ 931.4	− 202.9	− 50.8	− 388.9	=	− 1.9
			+ 992.7	− 200.4	+ 56.0	=	+ 0.9
				+ 729.8	− 47.5	=	−13.4
					+ 557.4	=	+ 6.7
					[nn]	=	1.44

x=+0.0051±0.0047	du=+0°.15 ± 0°.13
y=−0.0005±0.0052	dN=−0°.03 ± 0°.27
z=+0.0005±0.0053	dI=+0°.02 ± 0°.24
u=−0.0031±0.0044	Q=195°.9 ±21°.3
v=−0.0168±0.0052	e=0.0044 ±0.0014
w=+0.0115±0.0067	da=+0″.075±0″.044
[vv]= 1.10	r= 0″.129
[$nn.6$]= 1.10	

Normal Equations and Solutions—Continued.

1911–12. U. S. Naval Observatory; Burton.

$+2061.6x$	$-265.8y$	$+402.8z$	$-228.2u$	$+220.6v$	$-8.5w$	=	$+4.7$
	$+1751.3$	-127.9	-121.5	-212.5	$+258.2$	=	$+1.7$
		$+1944.2$	$+104.3$	$+33.6$	-780.6	=	-8.8
			$+2296.0$	-313.1	-17.3	=	$+33.5$
				$+1627.3$	-86.5	=	-16.4
					$+1500.0$	=	$+20.2$
					$[nn]$	=	2.20

$x=+0.0050\pm0.0020$	$du=+0^{\circ}.14\ \pm0^{\circ}.06$
$y=-0.0003\pm0.0021$	$dN=-0^{\circ}.02\ \pm0^{\circ}.11$
$z=-0.0012\pm0.0022$	$dI=-0^{\circ}.06\ \pm0^{\circ}.10$
$u=+0.0141\pm0.0018$	$Q=108^{\circ}.8\ \pm6^{\circ}.1$
$v=-0.0072\pm0.0022$	$e=0.0056\ \pm0.0006$
$w=+0.0127\pm0.0025$	$da=+0''.083\pm0''.016$
$[vv]=\ 1.32$	$r=\ 0''.086$
$[nn.6]=\ 1.33$	

1912–13. Yerkes Observatory; Barnard.

$+1543.1x$	$-412.1y$	$+237.2z$	$+306.1u$	$-136.0v$	$-35.5w$	=	$+1.4$
	$+1360.8$	-281.9	$+100.4$	$+149.5$	$+315.4$	=	-10.8
		$+1545.2$	-75.9	$+6.2$	-633.7	=	-10.6
			$+1603.3$	-391.3	-56.7	=	-0.6
				$+1210.6$	$+132.6$	=	-28.4
					$+971.9$	=	-0.2
					$[nn]$	=	3.55

$x=-0.0004\pm0.0041$	$du=-0^{\circ}.01\ \pm\ 0^{\circ}.12$
$y=-0.0065\pm0.0044$	$dN=-0^{\circ}.34\ \pm\ 0^{\circ}.23$
$z=-0.0083\pm0.0045$	$dI=-0^{\circ}.38\ \pm\ 0^{\circ}.21$
$u=-0.0063\pm0.0040$	$Q=201^{\circ}.2\ \pm11^{\circ}.6$
$v=-0.0248\pm0.0045$	$e=0.0066\ \pm0.0013$
$w=-0.0003\pm0.0058$	$da=-0''.002\pm0''.037$
$[vv]=\ 2.70$	$r=\ 0''.148$
$[nn.6]=\ 2.68$	

1912–13. U. S. Naval Observatory; A. Hall, Jr.

$+823.8x$	$+81.1y$	$+115.6z$	$+301.3u$	$-11.5v$	$-92.3w$	=	$+7.5$
	$+838.4$	-90.3	$+109.3$	$+86.2$	$+291.5$	=	-4.4
		$+685.2$	$+47.8$	$+79.0$	-243.7	=	$+0.7$
			$+793.2$	-170.9	-73.2	=	$+15.1$
				$+546.1$	$+206.3$	=	$+12.6$
					$+699.3$	=	$+14.4$
					$[nn]$	=	2.74

$x=+0.0039\pm0.0056$	$du=+0^{\circ}.11\ \pm0^{\circ}.16$
$y=-0.0205\pm0.0056$	$dN=-1^{\circ}.06\ \pm0^{\circ}.29$
$z=+0.0019\pm0.0062$	$dI=+0^{\circ}.10\ \pm0^{\circ}.32$
$u=+0.0281\pm0.0059$	$Q=\ 53^{\circ}.1\ \pm8^{\circ}.3$
$v=+0.0251\pm0.0072$	$e=0.0105\ \pm0.0020$
$w=+0.0258\pm0.0069$	$da=+0''.168\pm0''.046$
$[vv]=\ 1.49$	$r=\ 0''.145$
$[nn.6]=\ 1.51$	

1912–13. U. S. Naval Observatory; Burton.

$+1332.2x$	$-174.8y$	$+150.6z$	$-114.0u$	$+264.8v$	$-80.7w$	=	-6.3
	$+1224.7$	-216.4	$+57.4$	-232.3	$+348.9$	=	$+5.4$
		$+1148.6$	$+102.8$	$+23.0$	-480.9	=	-10.2
			$+1024.3$	-275.4	-59.4	=	-2.9
				$+989.6$	-20.3	=	$+4.1$
					$+941.7$	=	$+6.9$
					$[nn]$	=	1.38

$x=-0.0047\pm0.0030$	$du=-0^{\circ}.13\ \pm\ 0^{\circ}.08$
$y=+0.0031\pm0.0032$	$dN=+0^{\circ}.16\ \pm\ 0^{\circ}.17$
$z=-0.0068\pm0.0035$	$dI=-0^{\circ}.31\ \pm\ 0^{\circ}.16$
$u=-0.0010\pm0.0034$	$Q=348^{\circ}.7\ \pm40^{\circ}.5$
$v=+0.0061\pm0.0036$	$e=0.0015\ \pm0.0008$
$w=+0.0023\pm0.0040$	$da=+0''.015\pm0''.026$
$[vv]=\ 1.23$	$r=\ 0''.104$
$[nn.6]=\ 1.22$	

Normal Equations and Solutions—Continued.

1913–14. Yerkes Observatory; Barnard.

+ 824.7x	− 162.0y	+ 120.1z	+ 184.8u	− 179.2v	− 47.2w	=	+ 9.1
	+ 801.4	− 175.4	− 16.7	+ 149.1	+ 241.6	=	−12.0
		+ 740.7	− 110.5	− 23.4	− 300.4	=	− 2.9
			+ 991.7	− 310.9	+ 0.6	=	+ 0.8
				+ 861.8	+ 61.6	=	−22.6
					+ 548.5	=	+ 5.2
					[nn]	=	2.34

x = +0.0058 ± 0.0056	du = +0°.17 ± 0°.16
y = −0.0150 ± 0.0059	dN = −0°.77 ± 0°.30
z = −0.0034 ± 0.0064	dI = −0°.16 ± 0°.29
u = −0.0094 ± 0.0052	Q = 203°.4 ± 11°.0
v = −0.0271 ± 0.0056	e = 0.0089 ± 0.0019
w = +0.0177 ± 0.0076	da = +0″.116 ± 0″.051
[vv] = 1.39	r = 0″.150
[nn.6] = 1.40	

1914–15. Yerkes Observatory; Barnard.

+ 241.7x	− 107.1y	+ 85.2z	− 45.0u	− 12.7v	+ 41.8w	=	+ 1.3
	+ 158.9	− 10.2	− 35.2	+ 2.4	− 38.3	=	− 2.4
		+202.2	− 7.9	− 4.4	− 94.1	=	− 3.2
			+ 233.2	− 20.6	+ 24.9	=	+ 0.7
				+ 226.5	− 22.6	=	− 8.3
					+ 145.7	=	+ 5.3
					[nn]	=	0.61

x = −0.0113 ± 0.0137	du = −0°.32 ± 0°.39
y = −0.0160 ± 0.0131	dN = −0°.83 ± 0°.68
z = +0.0017 ± 0.0143	dI = +0°.06 ± 0°.49
u = −0.0084 ± 0.0095	Q = 203°.8 ± 24°.1
v = −0.0345 ± 0.0085	e = 0.0094 ± 0.0027
w = +0.0324 ± 0.0160	da = +0″.212 ± 0″.104
[vv] = 0.14	r = 0″.126
[nn.6] = 0.14	

1915–16. Yerkes Observatory; Barnard.

+1392.5x	− 444.0y	+ 285.4z	− 210.2u	+ 333.0v	− 37.2w	=	+ 5.8
	+1326.3	− 339.8	− 25.5	− 251.3	+ 361.4	=	+ 2.1
		+1378.8	+ 288.5	+ 162.9	− 515.3	=	−10.8
			+1504.4	− 466.6	− 53.6	=	+ 6.7
				+1028.1	− 12.2	=	−13.1
					+ 779.3	=	+ 7.9
					[nn]	=	3.34

x = +0.0090 ± 0.0050	du = +0°.26 ± 0°.14
y = −0.0014 ± 0.0053	dN = −0°.07 ± 0°.27
z = −0.0064 ± 0.0056	dI = −0°.29 ± 0°.26
u = +0.0030 ± 0.0049	Q = 162°.1 ± 31°.6
v = −0.0135 ± 0.0060	e = 0.0036 ± 0.0013
w = +0.0070 ± 0.0074	da = +0″.046 ± 0″.049
[vv] = 2.94	r = 0″.167
[nn.6] = 2.97	

1916–17. Yerkes Observatory; Barnard.

+1712.4x	− 572.1y	+ 505.8z	+ 478.2u	− 457.8v	+ 26.4w	=	+28.4
	+1661.5	− 416.7	− 108.4	+ 446.0	+ 360.0	=	−13.3
		+1976.6	− 184.8	− 83.5	− 689.1	=	+17.8
			+1881.0	− 669.2	+ 39.2	=	+24.5
				+1858.0	+ 112.1	=	−33.3
					+1058.3	=	− 6.1
					[nn]	=	4.05

x = +0.0098 ± 0.0042	du = +0°.28 ± 0°.12
y = +0.0012 ± 0.0041	dN = +0°.06 ± 0°.21
z = +0.0064 ± 0.0041	dI = +0°.29 ± 0°.19
u = +0.0066 ± 0.0038	Q = 147°.3 ± 18°.9
v = −0.0130 ± 0.0038	e = 0.0046 ± 0.0010
w = −0.0010 ± 0.0055	da = −0″.007 ± 0″.036
[vv] = 3.08	r = 0″.148
[nn.6] = 3.08	

Normal Equations and Solutions—Continued.

1917–18. Yerkes Observatory; Barnard.

+1133.4x	− 440.7y	+ 262.9z	− 481.3u	+ 135.7v	− 11.6w	=	+ 3.9
	+ 1193.5	− 384.4	− 4.4	− 235.3	+ 325.2	=	− 2.6
		+1235.5	+ 2.7	− 70.8	− 451.2	=	+ 5.3
			+1306.8	− 541.3	+ 138.6	=	+20.5
				+1178.5	− 253.4	=	−28.9
					+ 678.7	=	+10.1
					[nn]	=	3.62

x = +0.0067 ± 0.0068	du = +0°.19 ± 0°.19
y = −0.0052 ± 0.0064	dN = −0°.27 ± 0°.33
z = +0.0041 ± 0.0063	dI = +0°.19 ± 0°.29
u = +0.0089 ± 0.0063	Q = 150°.8 ± 21°.7
v = −0.0197 ± 0.0062	e = 0.0068 ± 0.0016
w = +0.0109 ± 0.0090	da = +0″.072 ± 0″.059
[vv] = 2.70	r = 0″.178
[nn.6] = 2.69	

1918–19. Yerkes Observatory; Barnard.

+1001.6x	− 205.3y	+ 366.2z	− 242.5u	+ 33.5v	− 15.5w	=	+ 3.4
	+1114.5	− 205.9	− 72.2	− 109.4	+ 299.8	=	+ 0.4
		+1197.8	− 56.2	− 29.9	− 363.8	=	+ 2.8
			+1316.7	− 367.4	+ 121.4	=	+ 9.2
				+1011.4	− 108.8	=	−20.6
					+ 732.2	=	+ 9.6
					[nn]	=	2.04

x = +0.0018 ± 0.0047	du = +0°.05 ± 0°.13
y = −0.0041 ± 0.0043	dN = −0°.21 ± 0°.22
z = +0.0050 ± 0.0044	dI = +0°.23 ± 0°.20
u = +0.0007 ± 0.0040	Q = 177°.0 ± 15°.2
v = −0.0189 ± 0.0044	e = 0.0057 ± 0.0013
w = +0.0144 ± 0.0057	da = +0″.095 ± 0″.037
[vv] = 1.48	r = 0″.131
[nn.6] = 1.50	

1918–19. U. S. Naval Observatory; A. Hall, Jr.

+1105.7x	− 127.9y	+ 401.0z	+ 65.4u	+ 188.8v	− 62.2w	=	− 5.2
	+1261.4	− 107.9	+ 48.9	− 99.3	+ 373.0	=	+ 3.6
		+1134.7	+ 95.9	+ 132.4	− 311.8	=	−11.2
			+1017.8	− 326.5	− 98.7	=	+26.1
				+1050.5	+ 120.5	=	+ 3.8
					+ 846.0	=	+13.9
					[nn]	=	4.40

x = −0.0057 ± 0.0059	du = −0°.16 ± 0°.17
y = −0.0034 ± 0.0056	dN = −0°.18 ± 0°.29
z = −0.0081 ± 0.0061	dI = −0°.37 ± 0°.28
u = +0.0330 ± 0.0060	Q = 67°.5 ± 8°.7
v = +0.0138 ± 0.0061	e = 0.0107 ± 0.0020
w = +0.0163 ± 0.0072	da = +0″.106 ± 0″.047
[vv] = 3.15	r = 0″.181
[nn.6] = 3.15	

1919–20. Yerkes Observatory; Barnard.

+1027.7x	− 368.5y	+ 341.2z	+ 78.8u	− 258.8v	+ 43.0w	=	− 9.2
	+1027.4	− 237.4	− 111.2	+ 173.7	+ 294.0	=	− 4.1
		+1097.5	− 138.5	− 121.1	− 430.5	=	−12.9
			+956.9	− 420.0	+ 138.1	=	+ 7.7
				+1053.4	− 49.6	=	−10.1
					+ 966.5	=	+11.7
					[nn]	=	2.19

x = −0.0151 ± 0.0054	du = −0°.43 ± 0°.16
y = −0.0127 ± 0.0053	dN = −0°.65 ± 0°.27
z = −0.0057 ± 0.0054	dI = −0°.25 ± 0°.23
u = 0.0000 ± 0.0054	Q = 180°.0 ± 30°.2
v = −0.0112 ± 0.0052	e = 0.0034 ± 0.0016
w = +0.0136 ± 0.0057	da = +0″.111 ± 0″.046
[vv] = 1.67	r = 0″.147
[nn.6] = 1.65	

Normal Equations and Solutions—Continued.

1919–20. U. S. Naval Observatory; A. Hall, Jr.

+743.8x	−61.8y	+345.9z	+136.9u	+139.1v	−27.7w	=	+5.0
	+665.3	−13.9	+77.2	−3.4	+198.8	=	+12.1
		+872.9	+105.8	+120.6	−201.8	=	+1.0
			+688.8	−192.8	−132.7	=	−1.5
				+725 0	+143.1	=	+11.2
					+609.7	=	+14.8
					[nn]	=	2.45

x = +0.0053 ± 0.0072	du = +0°.15 ± 0°.21
y = +0.0130 ± 0.0071	dN = +0°.60 ± 0°.33
z = +0.0020 ± 0.0067	dI = +0°.09 ± 0°.31
u = +0.0016 ± 0.0071	Q = 8°.8 ± 36°.5
v = +0.0108 ± 0.0069	e = 0.0032 ± 0.0022
w = +0.0188 ± 0.0080	da = +0".122 ± 0".052
[vv] = 1.87	r = 0".168
[nn.6] = 1.87	

1920–21. Yerkes Observatory; Barnard.

+1311.3x	−393.2y	+391.6z	−78.5u	−107.0v	−41.1w	=	+4.2
	+1288.4	−373.0	−28.5	−11.8	+421.1	=	−17.6
		+1425.9	−116.4	−155.2	−431.2	=	−0.5
			+1144.1	−532.6	+82.0	=	+20.6
				+1190.9	−118.5	=	−32.0
					+793.5	=	+2.4
					[nn]	=	3.23

x = −0.0020 ± 0.0042	du = −0°.06 ± 0°.12
y = −0.0175 ± 0.0045	dN = −0°.80 ± 0°.21
z = −0.0053 ± 0.0043	dI = −0°.24 ± 0°.20
u = +0.0048 ± 0.0047	Q = 169°.6 ± 11°.3
v = −0.0253 ± 0.0046	e = 0.0077 ± 0.0013
w = +0.0051 ± 0.0059	da = +0".033 ± 0".039
[vv] = 2.00	r = 0".138
[nn.6] = 2.01	

1920–21. U. S. Naval Observatory; A. Hall, Jr.

+873.4x	−0.2y	+564.0z	+389.0u	+11.1v	−0.6w	=	+20.7
	+924.0	+116.6	+84.5	+210.0	+189.3	=	+20.5
		+1244.7	+110.6	+144.8	−221.5	=	+8.3
			+831.6	−168.9	−196.0	=	+5.8
				+895.9	+258.3	=	+30.3
					+835.4	=	+27.1
					[nn]	=	4.55

x = +0.0243 ± 0.0081	du = +0°.70 ± 0°.23
y = +0.0120 ± 0.0060	dN = +0°.62 ± 0°.31
z = −0.0052 ± 0.0063	dI = −0°.24 ± 0°.29
u = +0.0055 ± 0.0072	Q = 11°.4 ± 15°.0
v = +0.0264 ± 0.0061	e = 0.0081 ± 0.0019
w = +0.0214 ± 0.0069	da = +0".140 ± 0".046
[vv] = 2.42	r = 0".166
[nn.6] = 2.44	

1921–22. Yerkes Observatory; Barnard.

+1240.4x	−546.9y	+551.7z	−89.4u	+60.0v	+149.7w	=	−2.0
	+1252.4	−347.8	+4.9	−56.6	+137.3	=	−1.8
		+1422.8	+35.9	+40.0	−434.6	=	−29.8
			+1205.5	−437.1	+3.8	=	+1.0
				+946.7	−0.6	=	−20.5
					+823.9	=	+19.5
					[nn]	=	4.09

x = +0.0015 ± 0.0060	du = +0°.04 ± 0°.17
y = −0.0087 ± 0.0052	dN = −0°.45 ± 0°.27
z = −0.0180 ± 0.0055	dI = −0°.69 ± 0°.21
u = −0.0076 ± 0.0051	Q = 203°.5 ± 12°.6
v = −0.0250 ± 0.0057	e = 0.0068 ± 0.0017
w = +0.0152 ± 0.0067	da = +0".099 ± 0".044
[vv] = 2.70	r = 0".160
[nn.6] = 2.74	

Normal Equations and Solutions—Continued.

1922–23. U. S. Naval Observatory; A. Hall, Jr.

$+401.6x$	$+15.7y$	$+273.4z$	$-40.2u$	$+203.6v$	$+23.9w$	=	$+7.4$
	$+379.5$	$+83.7$	$+103.7$	-97.1	$+28.5$	=	-1.8
		$+437.2$	$+115.0$	$+122.4$	-65.0	=	$+3.5$
			$+369.0$	-55.7	-101.2	=	-2.9
				$+319.7$	$+72.1$	=	$+13.4$
					$+310.5$	=	$+10.4$
					$[nn]$	=	2.15

$x=-0.0044\pm0.0151$	$du=-0''.13\pm0''.43$
$y=+0.0016\pm0.0114$	$dN=+0''.08\pm0''.59$
$z=+0.0029\pm0.0139$	$dI=+0''.10\pm0''.48$
$u=+0.0035\pm0.0117$	$Q=5^\circ.9\pm20^\circ.8$
$v=+0.0384\pm0.0144$	$e=0.0097\pm0.0036$
$w=+0.0270\pm0.0122$	$da=+0''.147\pm0''.067$
$[vv]=1.40$	$r=0''.188$
$[nn.6]=1.39$	

GREENWICH OBSERVATIONS.

The photographic observations of the satellite of Neptune made at the Greenwich Observatory are discussed in the Greenwich Observations for 1904–1908 and 1911. The tabular places there given are computed from the same elements as given on page 282 of this volume, except that in the case of the Greenwich work Struve's value of $a=16''.27$ was used. As stated on page 850, Monthly Notices of the Royal Astronomical Society for June, 1905, the Greenwich results from the solution of the normal equations are to be subtracted from the tabular elements. Since all our results are additive, we have changed the signs of the Greenwich results, before entering them in the table below. The differences from the numerical values of the Greenwich results, as published in their annual volumes that occur in the following table, are due to changes made in the Greenwich data and published in our table of errata on pages 336–337.

Normal Equations and Solutions (Greenwich)

Opposition 1901–02

sin du	sin dN	sin dI	$2e$ sin Q	$2e$ cos Q	$\frac{da}{a}$		
$+9927$	-1504	$+96$	$+1131$	$+1189$	$+930$	=	$+148.14$
	$+2684$	$+687$	$+139$	-660	-1602	=	$+4.44$
		$+3935$	$+141$	$+120$	-3295	=	$+31.88$
			$+4241$	$+1516$	-169	=	$+19.34$
				$+8059$	$+1260$	=	$+15.47$
					$+9526$	=	-53.08
					$[pnn]$	=	4.08

sin $du=+0.01651\pm0.00125$	$du=+0''.95\pm0''.07$
sin $dN=+0.00748\pm0.00250$	$dN=+0''.43\pm0''.14$
sin $dI=+0.00182\pm0.00224$	$dI=+0''.10\pm0''.13$
$2e$ sin $Q=-0.00074\pm0.00189$	$Q=325^\circ.1\pm74^\circ.1$
$2e$ cos $Q=+0.00106\pm0.00138$	$e=0.0006\pm0.0009$
$\frac{da}{a}=-0.00545\pm0.00148$	$da=-0''.089\pm0''.024$
$[pvv]=1.26$	$r=0''.117$
$[pnn.6]=1.26$	

Opposition 1902–03

sin du	sin dN	sin dI	$2e$ sin Q	$2e$ cos Q	$\frac{da}{a}$		
$+11430$	-673	-400	-406	$+1106$	$+222$	=	$+123.09$
	$+3060$	$+158$	-280	-301	-618	=	$+18.17$
		$+4120$	$+528$	-69	-3471	=	$+36.90$
			$+5479$	$+628$	-86	=	-7.39
				$+9307$	-590	=	-1.77
					$+13333$	=	-93.48
					$[pnn]$	=	7.83

sin $du=+0.01160\pm0.00189$	$du=+0''.66\pm0''.11$
sin $dN=+0.00688\pm0.00364$	$dN=+0''.39\pm0''.21$
sin $dI=+0.00512\pm0.00354$	$dI=+0''.29\pm0''.20$
$2e$ sin $Q=-0.00053\pm0.00273$	$Q=198^\circ.0\pm86^\circ.9$
$2e$ cos $Q=-0.00163\pm0.00209$	$e=0.0009\pm0.0010$
$\frac{da}{a}=-0.00563\pm0.00196$	$da=-0''.092\pm0''.032$
$[pvv]=5.57$	$r=0''.199$
$[pnn.6]=5.55$	

Normal Equations and Solutions (*Greenwich*)—Continued.

Opposition 1903–04

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+10146	− 1547	− 710	− 108	− 2758	− 581	=	+127.67
	+ 2468	− 175	− 334	+ 1233	+ 496	=	+ 5.87
		+ 4232	− 715	+ 230	− 3579	=	+ 8.18
			+ 3956	− 210	+ 563	=	− 2.70
				+ 8714	− 12	=	− 26.23
					+10074	=	− 34.39
					$[pnn]$	=	3.64

$\sin du = +0.01458 \pm 0.00132$ $\quad du = +0^\circ.84 \pm 0^\circ.08$

$\sin dN = +0.01250 \pm 0.00264$ $\quad dN = +0^\circ.72 \pm 0^\circ.15$

$\sin dI = +0.00349 \pm 0.00229$ $\quad dI = +0^\circ.20 \pm 0^\circ.13$

$2e \sin Q = +0.00167 \pm 0.00197$ $\quad Q = 97^\circ.5 \pm 50^\circ.2$

$2e \cos Q = -0.00022 \pm 0.00138$ $\quad e = 0.0008 \pm 0.0010$

$\frac{da}{a} = -0.00201 \pm 0.00146$ $\quad da = -0''.033 \pm 0''.024$

$[pvv] = 1.58$ $\quad r = 0''.121$

$[pnn.6] = 1.60$

Opposition 1904–05

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+11304	− 1643	+ 209	+ 808	+ 2071	+ 319	=	+115.20
	+ 2753	+ 175	+ 368	− 607	− 440	=	+ 34.81
		+ 4561	+ 1005	+ 43	− 3933	=	+ 49.44
			+ 4506	+ 299	− 59	=	+ 11.77
				+ 9619	+ 931	=	− 27.46
					+11270	=	− 92.28
					$[pnn]$	=	5.86

$\sin du = +0.01395 \pm 0.00162$ $\quad du = +0^\circ.80 \pm 0^\circ.09$

$\sin dN = +0.01916 \pm 0.00325$ $\quad dN = +1^\circ.10 \pm 0^\circ.19$

$\sin dI = +0.00509 \pm 0.00295$ $\quad dI = +0^\circ.29 \pm 0^\circ.17$

$2e \sin Q = -0.00240 \pm 0.00252$ $\quad Q = 210^\circ.7 \pm 29^\circ.3$

$2e \cos Q = -0.00404 \pm 0.00168$ $\quad e = 0.0023 \pm 0.0010$

$\frac{da}{a} = -0.00574 \pm 0.00184$ $\quad da = -0''.093 \pm 0''.030$

$[pvv] = 2.72$ $\quad r = 0''.161$

$[pnn.6] = 2.72$

Opposition 1905–06

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+12447	− 2913	+ 114	+ 104	− 1461	− 514	=	+148.97
	+ 2898	− 314	− 122	+ 431	+ 655	=	+ 14.59
		+ 5516	− 702	+ 54	− 4835	=	+ 5.99
			+ 3995	− 690	+ 75	=	+ 15.40
				+11058	+ 62	=	− 46.25
					+10464	=	− 38.33
					$[pnn]$	=	5.34

$\sin du = +0.01695 \pm 0.00156$ $\quad du = +0^\circ.97 \pm 0^\circ.09$

$\sin dN = +0.02358 \pm 0.00323$ $\quad dN = +1^\circ.35 \pm 0^\circ.19$

$\sin dI = -0.00210 \pm 0.00269$ $\quad dI = -0^\circ.12 \pm 0^\circ.15$

$2e \sin Q = +0.00342 \pm 0.00245$ $\quad Q = 127^\circ.4 \pm 25^\circ.7$

$2e \cos Q = -0.00261 \pm 0.00146$ $\quad e = 0.0022 \pm 0.0010$

$\frac{da}{a} = -0.00528 \pm 0.00193$ $\quad da = -0''.086 \pm 0''.031$

$[pvv] = 2.14$ $\quad r = 0''.151$

$[pnn.6] = 2.11$

Normal Equations and Solutions (*Greenwich*)—Continued.

Opposition 1906–07

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+ 5607	− 709	+ 137	− 716	+ 1000	− 15	=	+ 89.95
	+ 1362	− 57	− 307	− 476	+ 142	=	+ 10.47
		+ 2167	+ 265	+ 33	− 1887	=	+ 7.42
			+ 2370	− 192	− 139	=	− 22.56
				+ 4759	− 765	=	+ 6.26
					+ 5829	=	− 0.68
					[pnn]	=	2.57

$\sin du = +0.01785 \pm 0.00177$	$du = +1^\circ.02 \pm 0^\circ.10$
$\sin dN = +0.01622 \pm 0.00357$	$dN = +0^\circ.93 \pm 0^\circ.20$
$\sin dI = +0.00347 \pm 0.00314$	$dI = +0^\circ.20 \pm 0^\circ.18$
$2e \sin Q = -0.00244 \pm 0.00266$	$Q = 250^\circ.8 \pm 42^\circ.1$
$2e \cos Q = -0.00085 \pm 0.00185$	$e = 0.0013 \pm 0.0013$
$\frac{da}{a} = +0.00049 \pm 0.00193$	$da = +0''.008 \pm 0''.031$
$[pvv] = 0.76$	$r = 0''.122$
$[pnn.6] = 0.72$	

Opposition 1907–08

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+ 5213	− 906	− 24	+ 124	− 426	− 255	=	+ 59.35
	+ 1259	− 258	+ 176	+ 218	+ 534	=	− 4.09
		+ 2095	− 74	− 83	− 1850	=	+ 20.26
			+ 2017	− 579	+ 90	=	− 18.02
				+ 4411	+ 106	=	− 26.01
					+ 4871	=	− 67.29
					[pnn]	=	3.20

$\sin du = +0.01297 \pm 0.00237$	$du = +0^\circ.74 \pm 0^\circ.14$
$\sin dN = +0.01497 \pm 0.00497$	$dN = +0^\circ.86 \pm 0^\circ.28$
$\sin dI = -0.00264 \pm 0.00427$	$dI = -0^\circ.15 \pm 0^\circ.24$
$2e \sin Q = -0.01237 \pm 0.00365$	$Q = 241^\circ.6 \pm 10^\circ.1$
$2e \cos Q = -0.00669 \pm 0.00246$	$e = 0.0070 \pm 0.0018$
$\frac{da}{a} = -0.01540 \pm 0.00283$	$da = -0''.251 \pm 0''.046$
$[pvv] = 1.11$	$r = 0''.159$
$[pnn.6] = 1.11$	

Opposition 1909–10

$\sin du$	$\sin dN$	$\sin dI$	$2e \sin Q$	$2e \cos Q$	$\frac{da}{a}$		
+11148	− 1285	+ 1026	− 436	− 2385	+ 163	=	+187.35
	+ 2707	− 221	− 649	+ 851	+ 516	=	+ 11.72
		+ 4333	− 769	− 156	− 3675	=	+ 45.68
			+ 4780	− 822	+ 712	=	+ 0.84
				+ 9257	− 951	=	− 28.52
					+11627	=	− 42.94
					[pnn]	=	4.85

$\sin du = +0.01846 \pm 0.00103$	$du = +1^\circ.06 \pm 0^\circ.06$
$\sin dN = +0.01526 \pm 0.00206$	$dN = +0^\circ.87 \pm 0^\circ.12$
$\sin dI = +0.00512 \pm 0.00184$	$dI = +0^\circ.29 \pm 0^\circ.11$
$2e \sin Q = +0.00533 \pm 0.00153$	$Q = 84^\circ.7 \pm 11^\circ.5$
$2e \cos Q = +0.00049 \pm 0.00110$	$e = 0.0027 \pm 0.0008$
$\frac{da}{a} = -0.00330 \pm 0.00111$	$da = -0''.054 \pm 0''.018$
$[pvv] = 0.85$	$r = 0''.101$
$[pnn.6] = 0.85$	

TABLE III.—*Longitude of Node and Inclination of Orbit.*

Observer.	Mean Epoch.	*N*		Δ*N*		*I*		Δ*I*	
		Obs.	Comp.	O–C	*v*	Obs.	Comp.	O–C	*v*
		° °	°	°	°	° °	°	°	°
Bond.	1848.3	178.37±0.86	179.87	[−1.50]	[−1.16]	125.05±0.45	126.02	[−0.97]	[−1.59]
O. Struve.	1848.6	182.39±1.00	179.90	[+2.49]	[+2.83]	126.24±0.48	125.97	[+0.27]	[−0.35]
Lassell (Starfield).	1849.8	176.70±0.50	180.01	[−3.31]	[−2.98]	126.55±0.21	125.75	[+0.80]	[+0.20]
Lassell (Malta).	1852.9	179.02±0.59	180.33	[−1.31]	[−1.00]	126.21±0.39	125.20	[+1.01]	[+0.46]
O. Struve.	1863.6	181.33±0.77	181.54	−0.21	0.00	124.22±0.32	123.35	+0.87	+0.50
Lassell and Marth.	1864.5	181.65±0.42	181.65	0.00	+0.21	124.19±0.28	123.20	+0.99	+0.63
Newcomb.	1874.5	183.03±0.14	182.96	+0.07	+0.18	121.70±0.10	121.57	+0.13	−0.08
Hall.	1876.3	183.47±0.33	183.21	+0.26	+0.34	121.64±0.19	121.29	+0.35	+0.17
Holden.	1876.5	182.79±0.30	183.24	−0.45	−0.37	121.04±0.18	121.26	−0.22	−0.40
Hall.	1882.1	184.05±0.15	184.06	−0.01	+0.01	120.03±0.11	120.40	−0.37	−0.46
Hall.	1883.8	184.67±0.21	184.31	+0.36	+0.36	120.13±0.23	120.14	−0.01	−0.08
H. Struve.	1887.6	184.48±0.15	184.90	−0.42	−0.47	119.38±0.13	119.58	−0.20	−0.22
H. Struve.	1889.0	185.05±0.11	185.12	−0.07	−0.14	119.53±0.09	119.38	+0.15	+0.15
Parrish.	1889.93	184.38±1.21	185.27	−0.89	−0.97	118.71±1.17	119.25	−0.54	−0.53
H. Struve.	1890.6	185.51±0.12	185.38	+0.13	+0.04	119.26±0.10	119.16	+0.10	+0.12
A. Hall, jr.	1892.00	185.86±0.39	185.60	+0.26	+0.16	118.93±0.36	118.96	−0.03	+0.01
H. Struve.	1892.6	185.56±0.18	185.70	−0.14	−0.25	119.06±0.15	118.88	+0.18	+0.23
Barnard.	1892.93	186.51±0.39	185.75	+0.76	+0.65	119.52±0.41	118.83	+0.69	+0.74
Barnard.	1894.00	185.91±0.36	185.93	−0.02	−0.15	118.80±0.37	118.68	+0.12	+0.19
Schaeberle.	1895.06	186.09±0.26	186.10	−0.01	−0.15	118.71±0.21	118.54	+0.17	+0.25
Barnard.	1895.07	186.55±0.23	186.10	+0.45	+0.31	118.65±0.22	118.54	+0.11	+0.19
Schaeberle.	1895.91	186.49±0.20	186.24	+0.25	+0.10	118.11±0.24	118.43	−0.32	−0.23
Schaeberle.	1896.82	187.07±0.30	186.40	+0.67	+0.50	118.59±0.29	118.30	+0.29	+0.40
Drew.	1897.09	186.38±0.33	186.44	−0.06	−0.23	118.29±0.29	118.27	+0.02	+0.13
Schaeberle.	1897.87	186.81±0.18	186.57	+0.24	+0.06	118.04±0.15	118.16	−0.12	0.00
Brown.	1897.97	186.73±0.18	186.59	+0.14	−0.04	117.79±0.15	118.15	−0.36	−0.24
Barnard.	1898.02	187.22±0.17	186.60	+0.62	+0.44	118.19±0.14	118.14	+0.05	+0.17
Drew.	1898.76	187.44±0.44	186.72	+0.72	+0.53	117.79±0.38	118.05	−0.26	−0.13
Aitken.	1898.89	188.33±0.34	186.74	+1.59	+1.39	116.94±0.27	118.03	−1.09	−0.96
Barnard.	1898.98	186.53±0.14	186.76	−0.23	−0.42	118.02±0.12	118.02	0.00	+0.13
Hussey.	1898.98	186.69±0.43	186.76	−0.07	−0.26	117.70±0.47	118.02	−0.32	−0.19
Pulkowa, photo.	1899.18	187.00±0.48	186.80	+0.20	0.00	118.74±0.41	117.99	+0.75	+0.88
Barnard.	1899.88	186.98±0.11	186.92	+0.06	−0.15	117.94±0.11	117.90	+0.04	+0.18
See.	1899.96	187.26±0.22	186.93	+0.33	+0.12	117.87±0.20	117.89	−0.02	+0.13
Hussey.	1900.04	186.69±0.40	186.94	−0.25	−0.46	117.97±0.39	117.88	+0.09	+0.24
Pulkowa, photo.	1900.12	185.99±0.42	186.96	−0.97	−1.18	118.93±0.45	117.87	+1.06	+1.21
Barnard.	1900.86	187.05±0.17	187.08	−0.03	−0.25	117.77±0.14	117.77	0.00	+0.16
Pulkowa, photo.	1901.11	188.94±1.35	187.13	+1.81	+1.59	118.22±1.14	117.74	+0.48	+0.64
Aitken.	1901.82	187.12±0.34	187.25	−0.13	−0.36	116.85±0.30	117.65	−0.80	−0.63
Barnard.	1902.00	187.69±0.15	187.28	+0.41	+0.17	117.87±0.14	117.63	+0.24	+0.41
Lick, photo.	1902.02	188.08±0.29	187.28	+0.80	+0.56	117.06±0.27	117.63	−0.57	−0.40
Greenwich, photo.	1902.15	187.38±0.14	187.31	+0.07	−0.17	117.45±0.13	117.61	−0.16	+0.01
Barnard.	1902.92	188.05±0.20	187.44	+0.61	+0.36	117.21±0.17	117.51	−0.30	−0.12
Dinwiddie	1903.01	187.10±0.35	187.46	−0.36	−0.61	117.79±0.35	117.50	+0.29	+0.47
Greenwich, photo.	1903.10	187.48±0.21	187.47	+0.01	−0.24	117.48±0.20	117.49	−0.01	+0.17
Wirtz.	1903.17	186.40±0.91	187.48	−1.08	−1.33	117.54±0.84	117.48	+0.06	+0.24
Barnard.	1903.96	187.56±0.28	187.62	−0.06	−0.32	117.37±0.24	117.38	−0.01	+0.18
Greenwich, photo.	1904.10	187.96±0.15	187.65	+0.31	+0.04	117.22±0.13	117.36	−0.14	+0.06
Barnard.	1904.88	187.55±0.30	187.78	−0.23	−0.51	116.80±0.27	117.27	−0.47	−0.26
Hammond.	1905.03	187.93±0.56	187.81	+0.12	−0.16	116.42±0.51	117.25	−0.83	−0.62
Greenwich, photo.	1905.10	188.48±0.19	187.82	+0.66	+0.38	117.15±0.17	117.24	−0.09	+0.12
Rice.	1905.11	187.40±0.58	187.83	−0.43	−0.71	117.02±0.42	117.24	−0.22	−0.01
Barnard.	1906.06	189.39±0.47	187.99	+1.40	+1.11	117.00±0.43	117.12	−0.12	+0.10
Hammond.	1906.09	188.76±0.19	188.00	+0.76	+0.47	116.40±0.19	117.12	−0.72	−0.50
Greenwich, photo.	1906.18	188.89±0.19	188.02	+0.87	+0.58	116.56±0.15	117.11	−0.55	−0.33
Barnard.	1907.11	188.74±0.21	188.18	+0.56	+0.25	116.72±0.19	117.00	−0.28	−0.05
Greenwich, photo.	1907.16	188.62±0.20	188.19	+0.43	+0.12	116.72±0.18	116.99	−0.27	−0.04
Barnard.	1908.08	188.55±0.22	188.36	+0.19	−0.13	116.63±0.19	116.88	−0.25	−0.01
Greenwich, photo.	1908.09	188.69±0.28	188.36	+0.33	+0.01	116.22±0.24	116.88	−0.66	−0.42
Hammond.	1908.11	188.72±0.31	188.36	+0.36	+0.04	117.27±0.34	116.87	+0.40	+0.64
Barnard.	1909.05	189.40±0.26	188.53	+0.87	+0.53	116.22±0.22	116.77	−0.55	−0.30
A. Hall, jr.	1909.11	189.63±0.36	188.54	+1.09	+0.75	116.47±0.35	116.76	−0.29	−0.04
Barnard.	1910.06	188.48±0.28	188.71	−0.23	−0.58	116.49±0.27	116.65	−0.16	+0.10
A. Hall, jr.	1910.12	189.16±0.31	188.72	+0.44	+0.09	115.74±0.30	116.64	−0.90	−0.63
Greenwich, photo.	1910.20	189.01±0.12	188.74	+0.27	−0.08	116.31±0.11	116.63	−0.32	−0.05

TABLE III.—*Longitude of Node and Inclination of Orbit*—Continued.

Observer.	Mean Epoch.	N		ΔN		I		ΔI	
		Obs.	Comp.	O–C	v	Obs.	Comp.	O–C	v
		° °	°	°	°	° °	°	°	°
Barnard.	1910.96	188.11±0.33	188.88	−0.77	−1.13	115.37±0.27	116.54	−1.17	−0.90
A. Hall, jr.	1911.18	188.79±0.30	188.92	−0.13	−0.50	115.70±0.28	116.52	−0.82	−0.54
Burton.	1911.18	188.30±0.30	188.92	−0.62	−0.99	116.62±0.30	116.52	+0.10	+0.38
Burton.	1912.12	189.60±0.11	189.09	+0.51	+0.13	116.15±0.10	116.41	−0.26	+0.03
Barnard.	1912.17	189.60±0.27	189.10	+0.50	+0.12	116.22±0.24	116.40	−0.18	+0.11
Barnard.	1913.05	189.48±0.23	189.26	+0.22	−0.17	115.73±0.21	116.31	−0.58	−0.28
A. Hall, jr.	1913.05	188.76±0.29	189.26	−0.50	−0.89	116.21±0.32	116.31	−0.10	+0.20
Burton.	1913.24	190.02±0.17	189.30	+0.72	+0.32	115.78±0.16	116.28	−0.50	−0.20
Barnard.	1914.01	189.25±0.30	189.44	−0.19	−0.60	115.84±0.29	116.20	−0.36	−0.05
Barnard.	1915.31	189.47±0.68	189.68	−0.21	−0.64	115.93±0.49	116.06	−0.13	+0.19
Barnard.	1916.13	190.41±0.27	189.84	+0.57	+0.13	115.49±0.26	115.97	−0.48	−0.15
Barnard.	1917.03	190.73±0.21	190.00	+0.73	+0.28	115.98±0.19	115.87	+0.11	+0.45
Barnard.	1918.12	190.64±0.33	190.21	+0.43	−0.04	115.78±0.29	115.75	+0.03	+0.38
A. Hall, jr.	1919.08	190.94±0.29	190.39	+0.55	+0.07	115.12±0.28	115.65	−0.53	−0.17
Barnard.	1919.12	190.92±0.22	190.40	+0.52	+0.04	115.72±0.20	115.65	+0.07	+0.43
A. Hall, jr.	1920.07	191.94±0.33	190.58	+1.36	+0.86	115.49±0.31	115.55	−0.06	+0.31
Barnard.	1920.13	190.70±0.27	190.59	+0.11	−0.39	115.14±0.23	115.55	−0.41	−0.04
Barnard.	1921.11	190.77±0.21	190.78	−0.01	−0.52	115.06±0.20	115.45	−0.39	−0.01
A. Hall, jr.	1921.13	192.20±0.31	190.78	+1.42	+0.90	115.06±0.29	115.44	−0.38	0.00
Barnard.	1922.14	191.35±0.27	190.98	+0.37	−0.16	114.52±0.21	115.34	−0.82	−0.43
A. Hall, jr.	1923.26	192.13±0.59	191.20	+0.93	+0.38	115.21±0.48	115.23	−0.02	+0.38

THE POLE OF NEPTUNE'S EQUATOR.

The values of N and I collected together in columns 3 and 7 of Table III were obtained from the preceding pages and from Struve's discussion in Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg VII[e] Série, Tome XLII, No. 4. The computed values of N and I, columns 4 and 8, are obtained from the formulæ below on the following assumptions: That the plane of Neptune's equator intersects the plane of the Earth's equator of 1900.0 in longitude 23°.56 and makes an angle with it of 49°.24; that the plane of the orbit of Neptune's satellite at 1900.0 intersects the plane of Neptune's equator in longitude 151°.72 measured on the Earth's equator of 1900.0 from the equinox of that date to the node of Neptune's equator and thence along Neptune's equator, and that it makes an angle of 161°.24 with the plane of Neptune's equator; and that while the inclination, 161°.24, is constant, the longitude of the node, 151°.72, increases 60°.08 per century.

Putting

N = Longitude of ascending node of orbit of Neptune's satellite on the Earth's equator;
I = Inclination of the orbit of Neptune's satellite to the Earth's equator;
N_0 = Longitude of node of Neptune's equator on the Earth's equator;
I_0 = Inclination of Neptune's equator to the Earth's equator;
θ = Longitude of ascending node of orbit of Neptune's satellite on Neptune's equator measured from the node of Neptune's equator on the Earth's equator;
$\delta\theta$ = Increase of θ in a century;
γ = Inclination of the orbit of Neptune's satellite to Neptune's equator;
ψ = Distance from ascending node of orbit of Neptune's satellite on the Earth's equator to the ascending node on Neptune's equator;

we have

$$\sin I \sin (N-N_0) = \sin \gamma \sin \theta$$
$$\sin I \cos (N-N_0) = \cos \gamma \sin I_0 + \sin \gamma \cos I_0 \cos \theta$$
$$\cos I = \cos \gamma \cos I_0 - \sin \gamma \sin I_0 \cos \theta$$
$$\sin I \sin \psi = \sin I_0 \sin \theta$$
$$\sin I \cos \psi = \sin \gamma \cos I_0 + \cos \gamma \sin I_0 \cos \theta$$

and to reduce from the equinox of 1900.0 to that of date

$$\Delta N_0 = (46''.08 - 20''.05 \cos N_0 \cot I_0)\ (T-1900.0)$$
$$\Delta I_0 = -20''.05\ (T-1900.0) \sin N_0$$
$$\Delta\theta = 20''.05\ (T-1900.0) \cos N_0 \csc I_0$$

Columns 5 and 9, respectively, of Table III give the differences between the N and I thus computed and those derived from the observations of the satellite. Each pair of differences in N and I for a given date furnishes two equations of condition between the corrections to the assumed quantities, N_o, I_o, θ, $\delta\theta$, and γ. These equations have the form:

$$dN_o - \cot I \sin (N - N_o)\, dI_o + \csc I \sin \gamma \cos \psi\, (d\theta_o + t \cdot d\delta\theta) + \csc I \sin \psi\, d\gamma = \Delta N \text{ (O–C)}$$

$$\cos (N - N_o)\, dI_o - \sin \gamma \sin \psi\, (d\theta_o + t \cdot d\delta\theta) + \cos \psi\, d\gamma = \Delta I \text{ (O–C)}$$

where t is the fraction of a century from 1900.0

Because of the large value of several of the early residuals it was decided not to use those before 1860.

In forming the normal equations, weights were assigned to the equations of condition in accordance with the probable errors of N and I, respectively, weight unity corresponding to a probable error of 1°.

The results of the solution of the normal equations are

$$\begin{aligned} dN_o &= +1.593^\circ \pm 2.42^\circ & N_o &= 25.153^\circ \pm 2.42^\circ \\ dI_o &= -0.588 \pm 1.38 & I_o &= 48.652 \pm 1.38 \\ d\theta_o &= -1.145 \pm 1.86 & \theta_o &= 127.015 \pm 1.86 \\ d\delta\theta &= +1.414 \pm 6.98 & \delta\theta &= 61.494 \pm 6.98 \\ d\gamma &= -1.295 \pm 2.27 & \gamma &= 159.945 \pm 2.27 \end{aligned}$$

giving for the position of the north pole of Neptune's equator

$$\left.\begin{aligned} A &= 295.2^\circ \\ D &= +41.3 \end{aligned}\right\} 1900.0$$

the period of the revolution of the pole of the satellite's orbit around the pole of Neptune's equator, 585 years, and the radius of the circle described by the pole of the satellite's orbit, 20°.1.*

Table IV gives the position of the plane of the satellite's orbit at 10-year intervals during the period of revolution, and the diagram below gives the observational positions of the pole of the satellite's orbit together with definitive path from 1848 to 1938.

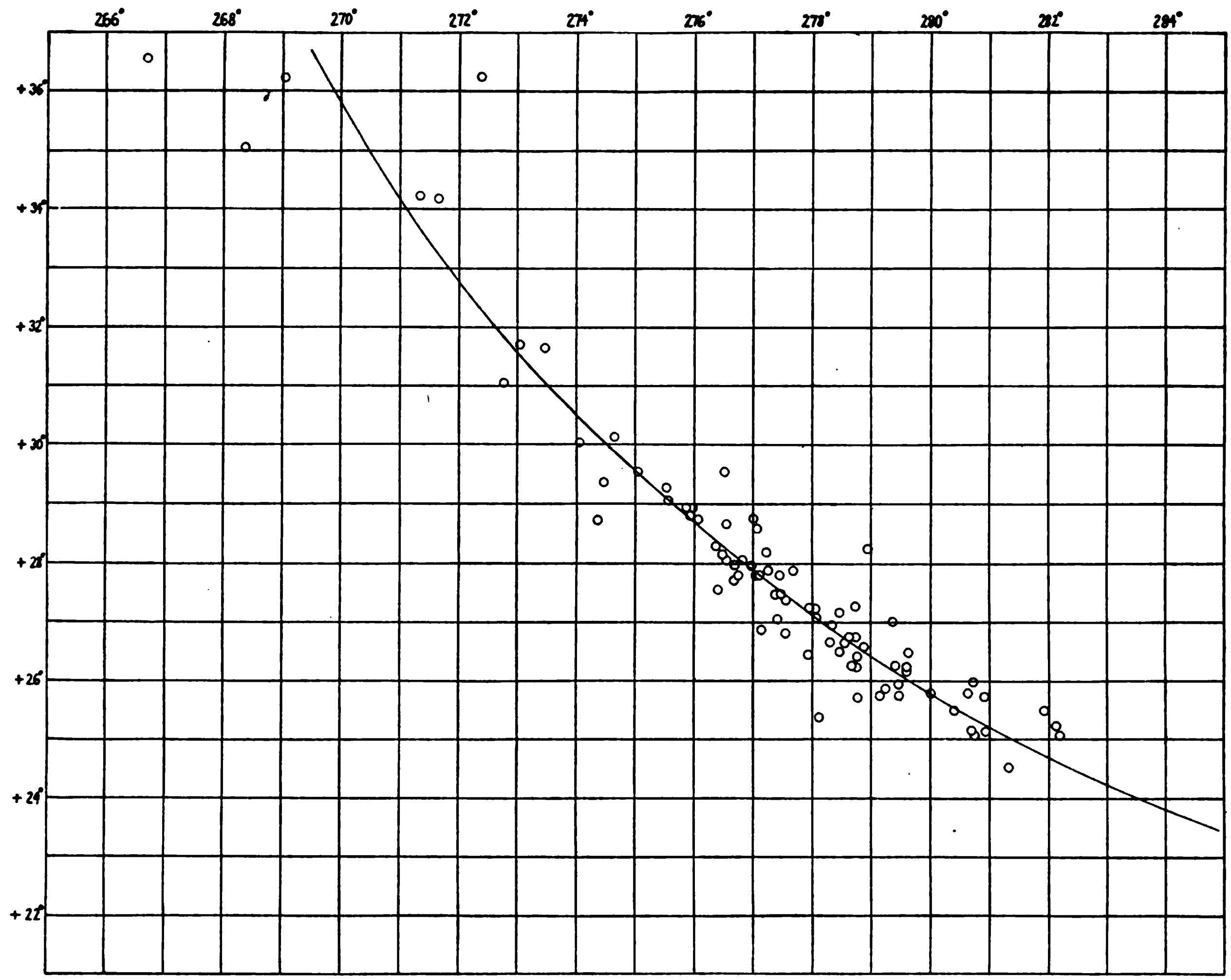
TABLE IV.—*Values of θ, N, I, and ψ at 10-year Intervals through One Revolution of the Node of the Satellite's Orbit on Neptune's Equator.*

[Mean Equator and Equinox of 1900.0.]

Date.	θ	N		I		ψ		Date	θ	N		I		ψ	
	°	°		°		°			°	°		°		°	
1840	90.1	179.2		128.3		73.1		2140	274.6	231.6		129.9		282.8	
1850	96.3	180.1	+0.9	126.3	−2.0	67.9	−5.2	2150	280.8	232.1	+0.5	132.0	+2.1	277.3	−5.5
1860	102.4	181.2	+1.1	124.4	−1.9	62.7	−5.2	2160	286.9	232.3	+0.2	134.0	+2.0	271.7	−5.6
1870	108.6	182.5	+1.3	122.6	−1.8	57.6	−5.1	2170	293.1	232.2	−0.1	136.2	+2.2	265.9	−5.8
1880	114.7	183.9	+1.4	120.9	−1.7	52.6	−5.0	2180	299.2	231.9	−0.3	138.3	+2.1	259.8	−6.1
1890	120.9	185.4	+1.5	119.2	−1.7	47.6	−5.0	2190	305.4	231.2	−0.7	140.3	+2.0	253.5	−6.3
1900	127.0	187.1	+1.7	117.8	−1.4	42.6	−5.0	2200	311.5	230.0	−1.2	142.3	+2.0	246.8	−6.7
1910	133.2	188.9	+1.8	116.4	−1.4	37.7	−4.9	2210	317.7	228.4	−1.6	144.2	+1.9	239.8	−7.0
1920	139.3	190.8	+1.9	115.2	−1.2	32.7	−5.0	2220	323.8	226.3	−2.1	145.9	+1.7	232.3	−7.5
1930	145.5	192.8	+2.0	114.1	−1.1	27.8	−4.9	2230	330.0	223.8	−2.5	147.5	+1.6	224.4	−7.9
1940	151.6	194.9	+2.1	113.2	−0.9	22.8	−5.0	2240	336.1	220.7	−3.1	148.9	+1.4	216.0	−8.4
1950	157.8	197.1	+2.2	112.5	−0.7	17.9	−4.9	2250	342.3	217.2	−3.5	150.0	+1.1	207.2	−8.8
1960	163.9	199.3	+2.2	111.9	−0.6	13.0	−4.9	2260	348.4	213.3	−3.9	150.8	+0.8	198.0	−9.2
1970	170.1	201.5	+2.2	111.5	−0.4	8.0	−5.0	2270	354.6	209.0	−4.3	151.3	+0.5	188.5	−9.5
1980	176.2	203.8	+2.3	111.3	−0.2	3.0	−5.0	2280	0.7	204.6	−4.4	151.4	+0.1	178.9	−9.6
1990	182.4	206.0	+2.2	111.3	0.0	358.1	−4.9	2290	6.8	200.3	−4.3	151.2	−0.2	169.3	−9.6
2000	188.5	208.3	+2.3	111.5	+0.2	353.2	−4.9	2300	13.0	196.1	−4.2	150.6	−0.6	159.9	−9.4
2010	194.7	210.5	+2.2	111.8	+0.3	348.2	−5.0	2310	19.1	192.3	−3.8	149.7	−0.9	150.8	−9.1
2020	200.8	212.7	+2.2	112.3	+0.5	343.2	−5.0	2320	25.3	188.8	−3.5	148.6	−1.1	142.0	−8.8
2030	207.0	214.9	+2.2	113.0	+0.7	338.3	−4.9	2330	31.4	185.9	−2.9	147.2	−1.4	133.8	−8.2
2040	213.1	217.0	+2.1	113.9	+0.9	333.4	−4.9	2340	37.6	183.5	−2.4	145.6	−1.6	126.0	−7.8
2050	219.3	219.0	+2.0	114.9	+1.0	328.4	−5.0	2350	43.7	181.5	−2.0	143.8	−1.8	118.6	−7.4
2060	225.4	220.9	+1.9	116.1	+1.2	323.5	−4.9	2360	49.9	180.0	−1.5	141.8	−2.0	111.6	−7.0
2070	231.6	222.8	+1.9	117.4	+1.3	318.5	−5.0	2370	56.0	179.0	−1.0	139.8	−2.0	105.1	−6.5
2080	237.7	224.5	+1.7	118.9	+1.5	313.6	−4.9	2380	62.2	178.3	−0.7	137.8	−2.0	98.8	−6.3
2090	243.9	226.1	+1.6	120.5	+1.6	308.6	−5.0	2390	68.3	178.0	−0.3	135.7	−2.1	92.8	−6.0
2100	250.0	227.5	+1.4	122.2	+1.7	303.6	−5.0	2400	74.5	178.0	0.0	133.6	−2.1	87.0	−5.8
2110	256.2	228.8	+1.3	124.0	+1.8	298.5	−5.1	2410	80.6	178.3	+0.3	131.5	−2.1	81.4	−5.6
2120	262.3	230.0	+1.2	125.9	+1.9	293.3	−5.2	2420	86.8	178.8	+0.5	129.4	−2.1	76.0	−5.4
2130	268.5	230.9	+0.9	127.9	+2.0	288.1	−5.2	2430	92.9	179.6	+0.8	127.4	−2.0	70.7	−5.3
2140	274.6	231.6	+0.7	129.9	+2.0	282.8	−5.3	2440	99.1	180.6	+1.0	125.5	−1.9	65.6	−5.1

* Previous determinations of this quantity are: By S. J. Brown in 1900, 18°; by Dyson and Edney in 1905, 22°; and by David Gibb in 1909, 21°.2.

Observational Positions of Pole of Satellite's Orbit with Definitive Path from 1848 to 1938.



LONGITUDE AND MOTION OF SATELLITE.

In column 3 of Table V are collected the values of the corrections to the assumed mean angular distance of the satellite in its orbit from the ascending node of the orbit on the Earth's equator,

$$u_{\oplus} = 234^{\circ}.42 + 61^{\circ}.25748\ (t_d - \text{Jan. 0, G. M. N., 1890})$$

From column 7 of Table VII can be obtained the distance, ψ, from the ascending node of the orbit of the satellite on the Earth's equator to the ascending node on Neptune's equator. If this is expressed in the form:

$$\psi = 47^{\circ}.31 - 0^{\circ}.00140\ (t_d - \text{Jan. 0, G. M. N., 1890}) + d\psi$$

the values of $d\psi$ are those given in column 4 of Table V.

Subtracting ψ from $u_{\oplus}$, there results the mean angular distance of the satellite in its orbit from the ascending node of the orbit on Neptune's equator,

$$u_{\Psi} = 187^{\circ}.11 + 61^{\circ}.25888\ (t_d - \text{Jan. 0, G. M. N., 1890}) + du_{\Psi}$$

The values of $du_{\Psi} = du_{\oplus} - d\psi$ are given in column 5 of Table V.

By the method of least squares the following value is obtained for du_{Ψ}:

$$du_{\Psi} = -0^{\circ}.190 \pm 0^{\circ}.019 + (0^{\circ}.0000694 \pm 0^{\circ}.0000052)(t_d - \text{Jan. 0, G. M. N., 1890})$$

and the residuals, v, are given in column 6 of Table V. The definitive value of u_{Ψ} is therefore,

$$u_{\Psi} = 186^{\circ}.92 + 61^{\circ}.2589494\ (t_d - \text{Jan. 0, G. M. N., 1890})$$

Column 7 of Table V gives mean values of the residuals in longitude obtained from the groups into which the quantities in column 6 are divided as indicated in the table. The apparent systematic character of these nine mean residuals is probably due to systematic differences in the observations at the different observatories. For instance, it is noted that all the photographic results at Greenwich are included in the fifth, sixth, and seventh groups, the only ones that give positive residuals, and if the means of these groups are formed from the results from the other observatories, the fifth and sixth mean residuals become negative and the seventh is reduced to one-half its published value. To obtain the daily sidereal motion of the satellite, it is necessary to subtract from the daily motion of u_{Ψ}, just given, the daily motion of θ multiplied by cos $(180° - \gamma)$, or 0.0015815. We thus have

$$\text{Daily sidereal motion} = 61°.2573679$$

This value differs only 0°.00008 from the first determination of this motion, that by S. J. Brown 25 years ago, when the position of Neptune's equator could be given only with great uncertainty.

TABLE V.—*Longitude in Orbit and Mean Distance.*

Observer.	Mean Epoch.	$du_{\oplus}$	$d\psi$	du_{Ψ}	v	v_m	a
		° °	°	°	°	°	" "
Bond.	1848.3	+1.98±0.98	+0.47	[+1.51]	[+2.76]	....	....
Lassell.	1852.9	−0.13±0.58	+0.40	[−0.53]	[+0.60]	....	....
Lassell and Marth.	1864.5	+0.59±0.51	+0.31	+0.28	+1.12	....	....
Newcomb.	1874.5	+0.03±0.13	+0.29	−0.26	+0.32	....	16.275±0.018
Hall.	1876.3	−0.41±0.27	+0.29	−0.70	−0.16	....	16.482±0.033
Holden.	1876.5	0.00±0.24	+0.29	−0.29	+0.24	....	16.598±0.035
Hall.	1882.1	+0.07±0.12	+0.31	−0.24	+0.15	....	16.368±0.022
Hall.	1883.8	+0.53±0.19	+0.32	+0.21	+0.56	....	16.263±0.028
H. Struve.	1887.6	−0.45±0.11	+0.34	−0.79	−0.54	....	16.285±0.028
H. Struve.	1889.0	0.00±0.08	+0.35	−0.35	−0.13	....	16.272±0.019
Parrish.	1889.93	−0.20±0.68	+0.36	−0.56	−0.37	−0.04	16.166±0.274
H. Struve.	1890.6	+0.05±0.08	+0.36	−0.31	−0.14	....	16.253±0.021
A. Hall, jr.	1892.00	+0.40±0.25	+0.37	+0.03	+0.17	....	16.579±0.068
H. Struve.	1892.6	+0.17±0.12	+0.38	−0.21	−0.09	....	16.293±0.032
Barnard.	1892.93	+0.70±0.25	+0.38	+0.32	+0.44	....	16.430±0.064
Barnard.	1894.00	+0.51±0.26	+0.39	+0.12	+0.21	....	16.282±0.051
Schaeberle.	1895.06	+0.34±0.15	+0.39	−0.05	+0.01	....	16.287±0.046
Barnard.	1895.07	+0.12+0.14	+0.39	−0.27	−0.21	....	16.313±0.041
Schaeberle.	1895.91	+0.43±0.14	+0.40	+0.03	+0.07	....	16.264±0.042
Schaeberle.	1896.82	+0.44±0.17	+0.41	+0.03	+0.05	−0.04	16.354±0.052
Drew.	1897.09	−0.02±0.18	+0.41	−0.43	−0.42	....	16.223±0.057
Schaeberle.	1897.87	+0.53±0.10	+0.42	+0.11	+0.10	....	16.393±0.029
Brown.	1897.97	+0.46±0.10	+0.42	+0.04	+0.03	....	16.272±0.029
Barnard.	1898.02	+0.35±0.09	+0.42	−0.07	−0.08	....	16.236±0.028
Drew.	1898.76	+0.57±0.22	+0.43	+0.14	+0.11	....	16.509±0.073
Aitken.	1898.89	+0.07±0.19	+0.43	−0.36	−0.40	....	16.039±0.059
Barnard.	1898.98	+0.22±0.07	+0.43	−0.21	−0.25	....	16.220±0.023
Hussey.	1898.98	+0.24±0.25	+0.43	−0.19	−0.23	....	16.380±0.062
Pulkowa, photo.	1899.18	+1.10±0.26	+0.43	+0.67	+0.63	−0.10	16.170±0.078
Barnard.	1899.88	+0.54±0.06	+0.44	+0.10	+0.04	....	16.284±0.018
See.	1899.96	+0.78±0.12	+0.44	+0.34	+0.28	....	16.544±0.036
Hussey.	1900.04	−0.09±0.20	+0.44	−0.53	−0.59	....	16.696±0.062
Pulkowa, photo.	1900.12	−0.16±0.22	+0.44	−0.60	−0.67	....	16.157±0.070
Barnard.	1900.86	+0.23±0.08	+0.44	−0.21	−0.29	....	16.311±0.028
Pulkowa, photo.	1901.11	+1.18±0.86	+0.45	+0.73	+0.65	....	15.925±0.267
Aitken.	1901.82	+0.76±0.18	+0.45	+0.31	+0.20	....	16.217±0.051
Barnard.	1902.00	+0.48±0.08	+0.46	+0.02	−0.09	....	16.365±0.024
Lick, photo.	1902.02	+0.43±0.15	+0.46	−0.03	−0.14	−0.07	16.186±0.044
Greenwich, photo.	1902.15	+0.95±0.07	+0.46	+0.49	+0.37	....	16.182±0.024
Barnard.	1902.92	+0.56±0.10	+0.46	+0.10	−0.04	....	16.365±0.034
Dinwiddie.	1903.01	+0.47±0.18	+0.46	+0.01	−0.13	....	16.328±0.051
Greenwich, photo.	1903.10	+0.66±0.11	+0.46	+0.20	+0.06	....	16.179±0.032
Wirtz.	1903.17	−1.14±0.46	+0.47	−1.61	−1.75	....	16.248±0.143
Barnard.	1903.96	+0.45±0.14	+0.47	−0.02	−0.18	....	16.341±0.047
Greenwich, photo.	1904.10	+0.84±0.08	+0.47	+0.37	+0.20	....	16.238±0.024
Barnard.	1904.88	+0.61±0.15	+0.48	+0.13	−0.05	....	16.427±0.047
Hammond.	1905.03	+0.60±0.28	+0.48	+0.12	−0.07	+0.12	16.235±0.086
Greenwich, photo.	1905.10	+0.80±0.09	+0.48	+0.32	+0.13	....	16.178±0.030
Rice.	1905.11	+0.52±0.28	+0.48	+0.04	−0.15	....	16.667±0.083
Barnard.	1906.06	+0.83±0.24	+0.49	+0.34	+0.12	....	16.554±0.090
Hammond.	1906.09	+0.94±0.10	+0.49	+0.45	+0.23	....	16.209±0.029
Greenwich, photo.	1906.18	+0.97±0.09	+0.49	+0.48	+0.26	....	16.185±0.031
Barnard.	1907.11	+0.72±0.10	+0.50	+0.22	−0.02	....	16.267±0.034
Greenwich, photo.	1907.16	+1.02±0.10	+0.50	+0.52	+0.28	....	16.279±0.031
Barnard.	1908.08	+0.48±0.11	+0.51	−0.03	−0.30	....	16.360±0.036
Greenwich, photo.	1908.09	+0.74±0.14	+0.51	+0.23	−0.04	+0.10	16.020±0.046

TABLE V.—*Longitude in Orbit and Mean Distance*—Continued.

Observer.	Mean Epoch.	$du_{\oplus}$	$d\psi$	du_{ψ}	v	v_m	a
		° °	°	°	°	°	" "
Hammond.	1908.11	+0.94±0.17	+0.51	+0.43	+0.16	----------	16.445±0.044
Barnard.	1909.05	+0.76±0.13	+0.53	+0.23	−0.06	----------	16.316±0.042
A. Hall, jr.	1909.11	+1.23±0.18	+0.53	+0.70	+0.41	----------	16.585±0.055
Barnard.	1910.06	+0.93±0.14	+0.54	+0.39	+0.07	----------	16.323±0.044
A. Hall, jr.	1910.12	+0.51±0.16	+0.54	−0.03	−0.35	----------	16.346±0.046
Greenwich, photo.	1910.20	+1.06±0.06	+0.54	+0.52	+0.20	----------	16.217±0.018
Barnard.	1910.96	+0.88±0.16	+0.54	+0.34	0.00	----------	16.411±0.054
A. Hall, jr.	1911.18	+1.09±0.16	+0.55	+0.54	+0.20	----------	16.380±0.037
Burton.	1911.18	+0.98±0.15	+0.55	+0.43	+0.08	+0.12	16.355±0.044
Burton.	1912.12	+0.96±0.06	+0.56	+0.40	+0.03	----------	16.383±0.016
Barnard.	1912.17	+0.97±0.13	+0.56	+0.41	+0.04	----------	16.375±0.044
Barnard.	1913.05	+0.84±0.12	+0.57	+0.27	−0.12	----------	16.298±0.037
A. Hall, jr	1913.05	+0.96±0.16	+0.57	+0.39	0.00	----------	16.468±0.046
Burton.	1913.24	+0.72±0.08	+0.57	+0.15	−0.25	----------	16.315±0.026
Barnard.	1914.01	+1.05±0.16	+0.58	+0.47	+0.05	----------	16.416±0.051
Barnard.	1915.31	+0.60±0.39	+0.59	+0.01	−0.44	----------	16.512±0.104
Barnard.	1916.13	+1.20±0.14	+0.60	+0.60	+0.13	----------	16.346±0.049
Barnard.	1917.03	+1.25±0.12	+0.61	+0.64	+0.15	−0.03	16.293±0.036
Barnard.	1918.12	+1.20±0.19	+0.62	+0.58	+0.06	----------	16.372±0.059
A. Hall, jr.	1919.08	+0.88±0.17	+0.63	+0.25	−0.30	----------	16.406±0.047
Barnard.	1919.12	+1.09±0.13	+0.63	+0.46	−0.09	----------	16.395±0.037
A. Hall, jr.	1920.07	+1.22±0.21	+0.64	+0.58	+0.01	----------	16.422±0.052
Barnard.	1920.13	+0.64±0.16	+0.64	0.00	−0.57	----------	16.411±0.046
Barnard.	1921.11	+1.04±0.12	+0.66	+0.38	−0.22	----------	16.333±0.039
A. Hall, jr.	1921.13	+1.80±0.23	+0.66	+1.14	+0.54	----------	16.440±0.046
Barnard.	1922.14	+1.18±0.17	+0.67	+0.51	−0.11	----------	16.399±0.044
A. Hall, jr.	1923.26	+1.04±0.43	+0.68	+0.36	−0.29	−0.15	16.447±0.067

MEAN DISTANCE OF SATELLITE AND MASS OF NEPTUNE.

In column 8 of Table V are collected 80 determinations of the mean distance of the satellite from its primary made from 1874 to 1923. These determinations range in value from 15″.9 to 16″.7 and indicate that, in addition to the accidental errors of the determinations, there are evident systematic differences between the determinations of different observers. Weighting the various determinations according to their probable errors, giving weight unity to a probable error of 0″.1, the following results are obtained by observers:

Hall,	3 determinations,	1876–1884,	$a = 16''.360 \pm 0''.015$
Struve,	4 determinations,	1887–1893,	$a = 16.271 \pm 0.012$
Schaeberle,	4 determinations,	1895–1898,	$a = 16.336 \pm 0.019$
Hammond,	3 determinations,	1905–1908,	$a = 16.276 \pm 0.023$
Burton,	3 determinations,	1911–1913,	$a = 16.363 \pm 0.013$
Barnard (Lick),	3 determinations,	1892–1895,	$a = 16.322 \pm 0.029$
Barnard (Yerkes),	25 determinations,	1898–1922,	$a = 16.321 \pm 0.009$
A. Hall, jr.,	8 determinations,	1909–1923,	$a = 16.425 \pm 0.016$
Greenwich, photo.,	8 determinations,	1902–1910,	$a = 16.201 \pm 0.013$
All visual,	66 determinations,	1874–1923,	$a = 16.333 \pm 0.007$
All photographic,	11 determinations,	1899–1910,	$a = 16.199 \pm 0.010$
Final mean,	77 determinations,	1874–1923,	$a = 16.289 \pm 0.006$

The probable error in each of the first six cases was determined from the sum of the weights of the individual determinations forming that mean; that in each of the last five cases was determined from the individual residuals.

From the last three values of a we obtain for the reciprocal of the mass of Neptune,

From Visual Observations,

19176 ± 25.

From Photographic Observations,

19655 ± 36.

From all Observations combined,

19331 ± 21.

The value used by Newcomb in his tables of Uranus, A. P., Volume VII, is 19314.

THE ECCENTRICITY OF SATELLITE'S ORBIT AND LONGITUDE OF PERIASTRON.

Columns 3 and 4 of Table VI contain the values of the eccentricity, e, and the longitude of periastron, Q, of the satellite orbit as given by Struve and earlier in this treatise. Weighting the values of e according to their probable errors, we obtain as the weighted mean

$$e_0 = 0.0049 \pm 0.0002$$

This result must not be taken as definitely demonstrating that the orbit of the satellite is elliptical. An eccentricity of this size would produce a difference between the periastron and apastron distances of less than 0.″2. Even though the orbit is circular, every set of elements deduced as above may be expected to exhibit an eccentricity due to the unavoidable errors of observation. The confirmation of the ellipticity of the orbit must be sought in the accordance of the various values of Q. During the entire period of observation there is not a single opposition when there are three independent determinations of elements that the range of the values of Q is not over 100°.

TABLE VI.—*Eccentricity and Longitude of Periastron.*

Observer.	Mean Epoch.	e	Q	ψ	ΔQ	Q_ψ	v_{I}	v_{II}	v_{III}	v_{IV}
			° °	°	°	°	°	°	°	°
Newcomb.	1874.5	0.0088 ± 0.0020	182 ± 7	55.5	−14.7	141	......	......	+ 16.6	− 53.1
Hall.	1876.3	0.0090 ± 0.0031	202 ± 14	54.6	13.7	161	......	......	+ 41.7	− 28.5
Holden.	1876.5	0.0051 ± 0.0020	88 ± 36	54.5	13.6	47	......	......	− 71.8	−142.0
Hall.	1882.1	0.0034 ± 0.0014	124 ± 24	51.7	10.3	83	......	......	− 20.3	− 91.7
Hall.	1883.8	0.0100 ± 0.0021	150 ± 11	50.8	9.4	109	......	......	+ 10.6	− 61.3
H. Struve.	1887.6	0.0050 ± 0.0013	267 ± 13	48.9	− 7.2	225	......	......	......	+ 64.4
H. Struve.	1889.0	0.0075 ± 0.0011	248 ± 8	48.2	6.4	206	......	......	......	+ 49.0
Parrish.	1889.93	0.0102 ± 0.0128	156.3 ± 41.7	47.7	5.8	114.4	......	......	......	− 40.3
H. Struve.	1890.6	0.0072 ± 0.0009	271 ± 6	47.4	5.4	229	......	......	......	+ 76.0
A. Hall, jr.	1892.00	0.0074 ± 0.0033	126.6 ± 16.0	46.7	4.6	84.5	......	......	+ 8.9	− 64.9
H. Struve.	1892.6	0.0083 ± 0.0014	248 ± 8	46.4	− 4.3	206	......	......	......	+ 58.1
Barnard.	1892.93	0.0022 ± 0.0028	177.4 ± 72.0	46.2	4.1	135.3	......	......	......	[−11.7]
Barnard.	1894.00	0.0065 ± 0.0026	107.0 ± 19.6	45.7	3.5	64.8	......	......	− 5.2	− 79.5
Schaeberle.	1895.06	0.0065 ± 0.0017	149.5 ± 13.5	45.1	2.9	107.3	......	......	+ 40.1	− 34.3
Barnard.	1895.07	0.0025 ± 0.0016	78.2 ± 35.5	45.1	2.8	35.9	......	......	− 31.2	−105.7
Schaeberle.	1895.91	0.0031 ± 0.0025	141.6 ± 19.4	44.7	− 2.4	99.3	......	......	+ 34.5	− 40.1
Schaeberle.	1896.82	0.0039 ± 0.0023	91.5 ± 26.2	44.2	1.8	49.1	......	......	− 13.2	− 88.0
Drew.	1897.09	0.0047 ± 0.0022	148.0 ± 22.8	44.1	1.7	105.6	......	......	......	− 30.8
Schaeberle.	1897.87	0.0047 ± 0.0013	77.7 ± 11.4	43.7	1.2	35.2	......	......	− 24.1	− 99.2
Brown.	1897.97	0.0059 ± 0.0009	0.0 ± 12.2	43.7	1.2	317.5	......	......	−101.6	−176.6
Barnard.	1898.02	0.0048 ± 0.0011	131.6 ± 10.6	43.6	− 1.1	89.1	−84.6	......	......	− 44.9
Drew.	1898.76	0.0050 ± 0.0021	4.6 ± 35.3	43.3	0.7	322.0	......	......	......	−170.1
Aitken.	1898.89	0.0126 ± 0.0024	85.5 ± 6.4	43.2	0.6	42.9	......	......	− 13.5	− 88.9
Barnard.	1898.98	0.0038 ± 0.0008	230.4 ± 13.3	43.1	0.6	187.9	+15.6	......	......	+ 56.3
Hussey.	1898.98	0.0016 ± 0.0024	50.2 ± 98.5	43.1	0.6	7.7	......	......	......	[−123.9]
Pulkowa, photo.	1899.18	0.0024 ± 0.0029	240.2 ± 67.0	43.0	− 0.5	197.7	......	......	......	[+ 66.6]
Barnard.	1899.88	0.0033 ± 0.0007	231.1 ± 12.7	42.7	− 0.1	188.5	+17.6	......	......	+ 59.2
See.	1899.96	0.0038 ± 0.0012	341.6 ± 21.9	42.7	0.0	298.9	......	......	−114.6	−190.2
Hussey.	1900.04	0.0048 ± 0.0019	30.3 ± 32.1	42.6	0.0	347.7	......	......	− 65.5	−141.1
Pulkowa, photo.	1900.12	0.0108 ± 0.0030	302.5 ± 10.7	42.6	+ 0.1	259.8	......	......	......	+131.1
Barnard.	1900.86	0.0076 ± 0.0010	249.9 ± 6.5	42.2	+ 0.5	207.2	+37.8	......	......	+ 80.4
Pulkowa, photo.	1901.11	0.0132 ± 0.0094	339.6 ± 39.9	42.1	0.6	296.9	......	......	......	+170.7
Aitken.	1901.82	0.0068 ± 0.0017	147.0 ± 17.5	41.7	1.1	104.2	......	......	+ 55.9	− 20.1
Barnard.	1902.00	0.0049 ± 0.0007	192.9 ± 12.1	41.6	1.2	150.1	−17.5	......	......	+ 26.2
Lick, photo.	1902.02	0.0123 ± 0.0019	289.0 ± 6.9	41.6	1.2	246.2	......	......	......	+122.4
Greenwich, photo.	1902.15	0.0006 ± 0.0009	325.1 ± 74.1	41.6	+ 1.2	282.3	......	......	......	[+158.8]
Barnard.	1902.92	0.0057 ± 0.0010	224.3 ± 12.0	41.2	1.7	181.4	+15.2	......	......	+ 59.9
Dinwiddie.	1903.01	0.0147 ± 0.0021	73.8 ± 7.2	41.1	1.7	31.0	......	......	− 14.0	− 90.3
Greenwich, photo.	1903.10	0.0009 ± 0.0010	198.0 ± 86.9	41.1	1.8	155.1	......	......	......	[+ 34.1]
Wirtz.	1903.17	0.0206 ± 0.0058	257.7 ± 12.8	41.0	1.8	214.9	......	......	......	+ 94.0
Barnard.	1903.96	0.0067 ± 0.0014	213.5 ± 14.5	40.6	+ 2.3	170.6	+ 6.0	......	......	+ 51.7
Greenwich, photo.	1904.10	0.0008 ± 0.0010	97.5 ± 50.2	40.6	2.4	54.5	......	......	......	[− 64.0]
Barnard.	1904.88	0.0059 ± 0.0017	234.7 ± 15.9	40.2	2.8	191.7	+28.5	......	......	+ 75.2
Hammond.	1905.03	0.0050 ± 0.0035	58.8 ± 28.1	40.1	2.9	15.8	......	......	− 23.5	−100.4
Greenwich, photo.	1905.10	0.0023 ± 0.0010	210.7 ± 29.3	40.1	2.9	167.7	......	......	......	+ 51.8
Rice.	1905.11	0.0084 ± 0.0037	127.3 ± 19.6	40.1	+ 3.0	84.2	......	......	+ 45.1	− 31.7
Barnard.	1906.06	0.0096 ± 0.0030	118.7 ± 12.8	39.6	3.5	75.6	−85.8	......	......	− 37.9
Hammond.	1906.09	0.0044 ± 0.0010	332.9 ± 15.3	39.6	3.5	289.8	......	......	−106.6	−183.6
Greenwich, photo.	1906.18	0.0022 ± 0.0010	127.4 ± 25.7	39.5	3.6	84.3	......	......	......	− 28.9
Barnard.	1907.11	0.0026 ± 0.0013	110.6 ± 22.5	39.1	+4.1	67.4	−92.4	......	......	− 43.5

TABLE VI.—*Eccentricity and Longitude of Periastron*—Continued.

Observer.	Mean Epoch.	e	Q	ψ	ΔQ	Q_F	v_I	v_{II}	v_{III}	v_{IV}
			° °	°	°	°	°	°	°	°
Greenwich, photo.	1907.16	0.0013 ± 0.0013	250.8 ± 42.1	39.0	+ 4.1	207.7	------	------	------	+ 97.0
Barnard.	1908.08	0.0056 ± 0.0009	193.5 ± 14.1	38.6	4.7	150.2	− 8.1	------	------	+ 41.8
Greenwich, photo.	1908.09	0.0070 ± 0.0018	241.6 ± 10.1	38.6	4.7	198.3	------	------	------	+ 90.0
Hammond.	1908.11	0.0022 ± 0.0017	339.1 ± 51.1	38.6	4.7	295.8	------	------	------	[−172.5]
Barnard.	1909.05	0.0078 ± 0.0015	218.2 ± 10.4	38.1	5.2	174.9	+18.1	------	------	+ 69.0
A. Hall, jr.	1909.11	0.0030 ± 0.0018	156.0 ± 43.1	38.1	+ 5.3	112.6	------	+87.4	+ 84.6	+ 6.8
Barnard.	1910.06	0.0090 ± 0.0015	200.3 ± 10.7	37.6	5.8	156.9	+ 1.7	------	------	+ 53.6
A. Hall, jr.	1910.12	0.0095 ± 0.0019	36.0 ± 10.7	37.6	5.8	352.6	------	−30.1	− 32.5	−110.5
Greenwich, photo.	1910.20	0.0027 ± 0.0008	84.7 ± 11.5	37.5	5.9	41.3	------	------	------	− 61.7
Barnard.	1910.96	0.0066 ± 0.0020	226.9 ± 14.0	37.1	6.3	183.5	+29.7	------	------	+ 82.5
A. Hall, jr.	1911.18	0.0046 ± 0.0017	114.3 ± 16.7	37.0	+ 6.5	70.8	------	+50.6	+ 48.6	− 29.7
Burton.	1911.18	0.0092 ± 0.0018	65.7 ± 9.3	37.0	6.5	22.2	------	------	0.0	− 78.3
Burton.	1912.12	0.0056 ± 0.0006	108.8 ± 6.1	36.6	7.0	65.2	------	------	+ 45.7	− 32.8
Barnard.	1912.17	0.0044 ± 0.0014	195.9 ± 21.3	36.5	7.0	152.4	+ 0.4	------	------	+ 54.4
Barnard.	1913.05	0.0066 ± 0.0013	201.2 ± 11.6	36.1	7.5	157.6	+ 7.0	------	------	+ 61.9
A. Hall, jr.	1913.05	0.0105 ± 0.0020	53.1 ± 8.3	36.1	+ 7.5	9.5	------	− 6.3	− 7.5	− 86.2
Burton.	1913.24	0.0015 ± 0.0008	348.7 ± 40.5	36.0	7.6	305.1	------	------	− 71.4	−150.2
Barnard.	1914.01	0.0089 ± 0.0019	203.4 ± 11.0	35.6	8.1	159.7	+10.6	------	------	+ 66.5
Barnard.	1915.31	0.0094 ± 0.0027	203.8 ± 24.1	35.0	8.8	160.0	+12.9	------	------	+ 70.1
Barnard.	1916.13	0.0036 ± 0.0013	162.1 ± 31.6	34.6	9.3	118.2	−27.7	------	------	+ 30.3
Barnard.	1917.03	0.0046 ± 0.0010	147.3 ± 18.9	34.1	+ 9.8	103.4	−41.1	------	------	+ 17.9
Barnard.	1918.12	0.0068 ± 0.0016	150.8 ± 21.7	33.6	10.5	106.7	−36.1	------	------	+ 24.0
A. Hall, jr.	1919.08	0.0107 ± 0.0020	67.5 ± 8.7	33.1	11.0	23.4	------	+22.0	+ 23.2	− 56.9
Barnard.	1919.12	0.0057 ± 0.0013	177.0 ± 15.2	33.1	11.0	132.9	− 8.4	------	------	+ 52.7
A. Hall, jr.	1920.07	0.0032 ± 0.0022	8.8 ± 36.5	32.6	11.6	324.6	------	−34.5	− 32.8	−113.2
Barnard.	1920.13	0.0034 ± 0.0016	180.0 ± 30.2	32.5	+11.6	135.9	− 3.8	------	------	+ 58.3
Barnard.	1921.11	0.0077 ± 0.0013	169.6 ± 11.3	32.1	12.2	125.3	−12.9	------	------	+ 50.2
A. Hall, jr.	1921.13	0.0081 ± 0.0019	11.4 ± 15.0	32.0	12.2	327.2	------	−29.4	− 27.2	−107.9
Barnard.	1922.14	0.0068 ± 0.0017	203.5 ± 12.6	31.5	12.8	159.2	+22.6	------	------	+ 86.7
A. Hall, jr.	1923.26	0.0097 ± 0.0036	5.9 ± 20.8	31.0	+13.4	321.5	------	−30.0	− 27.0	−108.1

The values of Q given in column 4 of Table VI are measured from the ascending node of the satellite's orbit on the Earth's equator. If from these values we subtract ψ, obtained from column 7 of Table VII, and $\Delta Q = (T-1900)\ \Delta\theta \cos(180-\gamma)$ we will obtain

$$Q_F = Q - \psi - \Delta Q,$$

the longitude of periastron referred to a fixed point in the satellite's orbit, its node on Neptune's equator at 1900.0. The values of Q_F are given in column 7 of Table VI.

Giving to each value of Q_F a weight in accordance with its probable error, weight unity corresponding to a probable error of 31°.6, we obtain from the 25 determinations by Barnard at Yerkes (the largest number of determinations by a single observer at a single instrument),

$$Q_F = 155^\circ.3 \pm 5^\circ.3 - (1^\circ.54 \pm 0^\circ.69)(T-1910.0)$$

Similarly, from the 8 determinations by A. Hall, jr., at Washington, 1909 to 1923, we obtain

$$Q_F = 11^\circ.1 \pm 7^\circ.8 - (2^\circ.38 \pm 1^\circ.83)(T-1915.0)$$

While the difference between the values of Q_F from these two series at 1915.0, 148° and 11°, is many times its probable error, 10°, indicating a large systematic difference between the results from these two observers, the difference between the annual motions of Q_F as determined by them is less than half of its probable error.

A comparison of the values of Q_F obtained by the other observers with the results from the observations of Barnard and A. Hall, jr., respectively, shows that all the Washington results agree fairly well among themselves and with the results from the visual observations at the Lick Observatory. These two series include 32 determinations with probable errors less than 50°, from 1874 to 1923, and yield for the value of Q_F

$$Q_F = 53^\circ.4 \pm 4^\circ.7 - (2^\circ.79 \pm 0^\circ.36)(T-1900.0)$$

Finally, a solution including all the values of Table VI, except the seven whose probable errors exceed 50°, gives

$$Q_F = 129^\circ.0 \pm 6^\circ.5 - (2^\circ.55 \pm 0^\circ.57)(T-1900.0)$$

Reducing to 1900.0 the first expressions obtained, we have:

$$\begin{array}{rl}
\text{I}, & Q_F = 170.7^\circ - 1.54^\circ\ (T\text{–}1900.0),\ 25\ \text{determinations by Barnard at Yerkes;} \\
\text{II}, & Q_F = 46.8 - 2.38\ (T\text{–}1900.0),\ 8\ \text{determinations by A. Hall, jr., at Washington;} \\
\text{III}, & Q_F = 53.4 - 2.79\ (T\text{–}1900.0),\ 32\ \text{determinations at Washington and Lick;} \\
\text{IV}, & Q_F = 129.0 - 2.55\ (T\text{–}1900.0),\ 73\ \text{determinations at various places.}
\end{array}$$

The residuals from these four solutions, v_{I}, v_{II}, v_{III}, and v_{IV}, are given in columns 8, 9, 10, and 11 of Table VI.

The above expressions for the longitude of periastron indicate an annual motion of the periastron between $-1^\circ\!.5$ and $-3^\circ\!.0$, a value considerably larger than one would be led to expect from the determination of the annual motion of the node, $\delta\theta = +0^\circ\!.6$, and they also show an exceedingly large range in the values of the longitude of periastron itself for the mean epoch of the observations. These results indicate that the existence of an ellipticity in the satellite's orbit is extremely uncertain.

Table VII gives annual values of the elements of Neptune s equator and of the orbit of its satellite, considered circular, from 1840 to 1960. This is accompanied by auxiliary tables to facilitate the computation of the position of the satellite in its orbit at any desired time.

ADDENDUM.

On the occasion of the presentation of the results of the above paper to the Royal Astronomical Society, Dr. J. Jackson of the Royal Observatory at Greenwich presented a Note on the Figure and Rotation Period of Neptune based on the results of this paper. The Note is published in full in Monthly Notices of the Royal Astronomical Society for March, 1926, pp. 294–6.

Doctor Jackson obtains a difference between the equatorial and polar diameters of $0''\!.04$, and for the period of rotation of Neptune 19^h, with an error not to exceed 3^h or 4^h.

An Example of the Computation of Position Angle, Distance, and Time of Elongation.

For the computation of the position angle and distance for February 20, 1929, $20^h\ 39^m$, Greenwich Civil Time = February 20, 1929, $16^h\ 37^m$, corrected for light time.

Table VII gives—

G. C. T.	N	I	ψ	u_ψ	Part of Year.
	°	°	°	°	
1929 Jan. 0.0	192.952	114.246	28.115	88.766	
1930 Jan. 0.0	193.166	114.149	27.616		
Feb. 0.0				99.027	.085
20 days				145.179	.055
16 hours				40.839	.002
37 minutes				1.574	.000
				15.385	.142

Interpolating N, I, and ψ for the part of the year, $0.^y142$, there is obtained

$$\begin{aligned} N &= 192.98^\circ \\ I &= 114.23 \\ \psi &= 28.044 \\ u_\psi &= 15.385 \\ u_\oplus = u_\psi + \psi &= 43.43 \end{aligned}$$

Using the final value of $a = 16.''289$ from page 329, the value of r given on page 282 becomes

$$r = \frac{[2.69003]}{\rho}$$

Taking the values of α, δ, and ρ from one of the national Almanacs and using the values of N, I, and $u_\oplus$ just given, the formulæ on page 282 give

$$\begin{aligned} \log r &= 1.2254 \\ \log \sin B &= 9.6954n \\ P &= 232.77^\circ \\ U &= 31.37 \\ u_\oplus - U &= 12.06 \\ p &= 29.46 \\ s &= 8.87'' \end{aligned}$$

Western elongation occurs when $u_\oplus - U = 90^\circ$ and eastern elongation when $u_\oplus - U = 270^\circ$; therefore, having $u_\oplus - U$ for a given date, to find the number of hours to the next following western elongation of the satellite, divide $90^\circ - (u_\oplus - U)$ by the hourly motion of $u_\oplus - U$; and to find the number of hours to the next following eastern elongation divide $270^\circ - (u_\oplus - U)$ by the hourly motion of $u_\oplus - U$; in either case, adding or subtracting 360° whenever necessary in order that the dividend may be between 0° and 360°.

In the present example, dividing $90^\circ - (u_\oplus - U) = 77.^\circ 94$ by $2.^\circ 5513$,* the result is $+30.^h55$ and a western elongation will occur on February 20, $20.^h65 + 30.^h55$ or 1929, February 22, $3.^h20$, G. C. T.

A series of earlier western elongations may next be computed by successive subtractions of the period, $5^d\ 21.^h044$, from February 22, $3.^h20$; and a series of later western elongations by successive additions of the period. The time of elongation, February 22, $3.^h20$ is correct as computed, but the other times will require a small correction in order to take account of the change in the motion of U and in the value of the light time.

Finally, the eastern elongations may be obtained from the western elongations by interpolation to the middle.

*The hourly motion of $u_\oplus$ is very nearly a constant, namely, $2.^\circ 5524$; that of U, however, varies both throughout each opposition of Neptune and from opposition to opposition. The hourly motion of U for the date of the present example is $+0.^\circ 0011$; and that of $u_\oplus - U$ is therefore $2.^\circ 5513$.

TABLE VII.—*Elements of Neptune's Equator and Satellite's Orbit.*

[Mean Equator and Equinox of Date.]

Greenwich Civil Time.	N_0	I_0	θ	N	I	ψ	u_ψ
	°	°	°	°	°	°	°
B 1840 Jan. 1.0	24.651	48.792	89.718	178.732	128.325	73.530	325.357
1841 Jan. 0.0	24.660	48.790	90.339	178.817	128.123	72.993	4.873
1842 Jan. 0.0	24.668	48.788	90.960	178.905	127.921	72.458	44.390
1843 Jan. 0.0	24.676	48.785	91.581	178.995	127.721	71.924	83.906
B 1844 Jan. 1.0	24.685	48.783	92.204	179.088	127.520	71.389	184.682
1845 Jan. 0.0	24.693	48.781	92.825	179.182	127.320	70.857	224.198
1846 Jan. 0.0	24.701	48.779	93.446	179.278	127.122	70.326	263.715
1847 Jan. 0.0	24.710	48.776	94.068	179.377	126.923	69.796	303.231
B 1848 Jan. 1.0	24.718	48.774	94.691	179.478	126.725	69.265	44.007
1849 Jan. 0.0	24.726	48.772	95.312	179.581	126.529	68.737	83.523
1850 Jan. 0.0	24.735	48.769	95.933	179.686	126.332	68.210	123.040
1851 Jan. 0.0	24.743	48.767	96.554	179.792	126.137	67.684	162.556
B 1852 Jan. 1.0	24.752	48.765	97.177	179.901	125.942	67.157	263.332
1853 Jan. 0.0	24.760	48.762	97.798	180.012	125.748	66.633	302.848
1854 Jan. 0.0	24.768	48.760	98.420	180.125	125.555	66.109	342.365
1855 Jan. 0.0	24.777	48.758	99.041	180.239	125.363	65.586	21.881
B 1856 Jan. 1.0	24.785	48.755	99.664	180.356	125.171	65.063	122.657
1857 Jan. 0.0	24.793	48.753	100.285	180.475	124.980	64.542	162.173
1858 Jan. 0.0	24.802	48.751	100.906	180.595	124.790	64.022	201.690
1859 Jan. 0.0	24.810	48.748	101.528	180.718	124.602	63.502	241.206
B 1860 Jan. 1.0	24.818	48.746	102.150	180.842	124.413	62.982	341.982
1861 Jan. 0.0	24.827	48.744	102.772	180.968	124.226	62.464	21.498
1862 Jan. 0.0	24.835	48.741	103.393	181.096	124.040	61.947	61.015
1863 Jan. 0.0	24.844	48.739	104.014	181.225	123.854	61.430	100.532
B 1864 Jan. 1.0	24.852	48.737	104.637	181.357	123.669	60.913	201.307
1865 Jan. 0.0	24.860	48.734	105.258	181.490	123.486	60.397	240.824
1866 Jan. 0.0	24.869	48.732	105.880	181.625	123.303	59.882	280.340
1867 Jan. 0.0	24.877	48.730	106.501	181.761	123.121	59.368	319.857
B 1868 Jan. 1.0	24.885	48.727	107.124	181.900	122.940	58.853	60.632
1869 Jan. 0.0	24.894	48.725	107.745	182.040	122.760	58.340	100.149
1870 Jan. 0.0	24.902	48.723	108.366	182.182	122.582	57.828	139.665
1871 Jan. 0.0	24.910	48.720	108.987	182.325	122.404	57.316	179.182
B 1872 Jan. 1.0	24.919	48.718	109.610	182.470	122.227	56.803	279.957
1873 Jan. 0.0	24.927	48.716	110.232	182.617	122.051	56.292	319.474
1874 Jan. 0.0	24.936	48.713	110.853	182.765	121.877	55.782	358.990
1875 Jan. 0.0	24.944	48.711	111.474	182.914	121.703	55.272	38.507
B 1876 Jan. 1.0	24.952	48.708	112.097	183.066	121.531	54.761	139.282
1877 Jan. 0.0	24.961	48.706	112.718	183.219	121.360	54.252	178.799
1878 Jan. 0.0	24.969	48.704	113.340	183.373	121.189	53.744	218.315
1879 Jan. 0.0	24.977	48.701	113.961	183.529	121.020	53.236	257.832
B 1880 Jan. 1.0	24.986	48.699	114.584	183.687	120.852	52.727	358.607
1881 Jan. 0.0	24.994	48.697	115.205	183.846	120.685	52.220	38.124
1882 Jan. 0.0	25.002	48.694	115.826	184.006	120.519	51.713	77.640
1883 Jan. 0.0	25.011	48.692	116.447	184.168	120.355	51.206	117.157
B 1884 Jan. 1.0	25.019	48.690	117.070	184.332	120.191	50.699	217.932
1885 Jan. 0.0	25.028	48.687	117.691	184.496	120.029	50.193	257.449
1886 Jan. 0.0	25.036	48.685	118.313	184.662	119.868	49.687	296.965
1887 Jan. 0.0	25.044	48.683	118.934	184.830	119.709	49.182	336.482
B 1888 Jan. 1.0	25.053	48.680	119.557	184.999	119.550	48.676	77.257
1889 Jan. 0.0	25.061	48.678	120.178	185.170	119.393	48.171	116.774
1890 Jan. 0.0	25.069	48.675	120.799	185.341	119.237	47.667	156.291
1891 Jan. 0.0	25.078	48.673	121.420	185.514	119.082	47.163	195.807
B 1892 Jan. 1.0	25.086	48.671	122.043	185.689	118.928	46.658	296.583
1893 Jan. 0.0	25.094	48.668	122.665	185.865	118.776	46.154	336.099
1894 Jan. 0.0	25.103	48.666	123.286	186.042	118.626	45.651	15.616
1895 Jan. 0.0	25.111	48.664	123.907	186.220	118.476	45.148	55.132
B 1896 Jan. 1.0	25.120	48.661	124.530	186.400	118.328	44.644	155.908
1897 Jan. 0.0	25.128	48.659	125.151	186.581	118.181	44.141	195.424
1898 Jan. 0.0	25.136	48.657	125.773	186.763	118.035	43.639	234.941
1899 Jan. 0.0	25.145	48.654	126.394	186.946	117.891	43.137	274.457

Reduction to Beginning of Months.

Month.	C	B	Part of Year.	u_ψ
				°
Jan.	0.0	1.0	0.000	0.000
Feb.	0.0	1.0	0.085	99.027
Mar.	0.0		0.162	14.278
Apr.	0.0		0.247	113.305
May	0.0		0.329	151.074
June	0.0		0.414	250.101
July	0.0		0.496	287.870
Aug.	0.0		0.581	26.897
Sept.	0.0		0.666	125.925
Oct.	0.0		0.748	163.693
Nov.	0.0		0.833	262.721
Dec.	0.0		0.915	300.489

Reduction for Days.

Day.	Part of Year.	u_ψ
		°
1	0.003	61.259
2	0.005	122.518
3	0.008	183.777
4	0.011	245.036
5	0.014	306.295
6	0.016	7.554
7	0.019	68.813
8	0.022	130.072
9	0.025	191.331
10	0.027	252.589
11	0.030	313.848
12	0.033	15.107
13	0.036	76.366
14	0.038	137.625
15	0.041	198.884
16	0.044	260.143
17	0.047	321.402
18	0.049	22.661
19	0.052	83.920
20	0.055	145.179
21	0.058	206.438
22	0.060	267.697
23	0.063	328.956
24	0.066	30.215
25	0.068	91.474
26	0.071	152.733
27	0.074	213.992
28	0.077	275.251
29	0.079	336.510
30	0.082	37.768
31	0.085	99.027

TABLE VII.—*Elements of Neptune's Equator and Satellite's Orbit*—Continued.

[Mean Equator and Equinox of Date.]

Greenwich Civil Time.	N_0	I_0	θ	N	I	ψ	u_{Ψ}
	°	°	°	°	°	°	°
1900 Jan. 0.0	25.153	48.652	127.015	187.130	117.748	42.635	313.974
1901 Jan. 0.0	25.161	48.650	127.636	187.316	117.607	42.133	353.490
1902 Jan. 0.0	25.170	48.647	128.257	187.503	117.467	41.631	33.007
1903 Jan. 0.0	25.178	48.645	128.879	187.691	117.329	41.129	72.523
B 1904 Jan. 1.0	25.186	48.643	129.502	187.880	117.191	40.627	173.299
1905 Jan. 0.0	25.195	48.640	130.123	188.071	117.055	40.125	212.815
1906 Jan. 0.0	25.203	48.638	130.744	188.262	116.921	39.624	252.332
1907 Jan. 0.0	25.212	48.635	131.365	188.455	116.788	39.123	291.848
B 1908 Jan. 1.0	25.220	48.633	131.988	188.649	116.656	38.621	32.624
1909 Jan. 0.0	25.228	48.631	132.610	188.844	116.526	38.120	72.140
1910 Jan. 0.0	25.237	48.628	133.231	189.040	116.398	37.620	111.657
1911 Jan. 0.0	25.245	48.626	133.852	189.237	116.271	37.119	151.173
B 1912 Jan. 1.0	25.253	48.624	134.475	189.435	116.145	36.618	251.949
1913 Jan. 0.0	25.262	48.621	135.096	189.634	116.021	36.117	291.465
1914 Jan. 0.0	25.270	48.619	135.717	189.834	115.898	35.617	330.982
1915 Jan. 0.0	25.278	48.617	136.338	190.035	115.777	35.117	10.499
B 1916 Jan. 1.0	25.287	48.614	136.962	190.238	115.657	34.615	111.274
1917 Jan. 0.0	25.295	48.612	137.583	190.441	115.539	34.115	150.791
1918 Jan. 0.0	25.304	48.609	138.204	190.645	115.423	33.616	190.307
1919 Jan. 0.0	25.312	48.607	138.825	190.850	115.308	33.116	229.824
B 1920 Jan. 1.0	25.320	48.605	139.448	191.057	115.195	32.614	330.599
1921 Jan. 0.0	25.329	48.602	140.069	191.264	115.083	32.115	10.116
1922 Jan. 0.0	25.337	48.600	140.690	191.471	114.973	31.615	49.632
1923 Jan. 0.0	25.346	48.597	141.312	191.680	114.864	31.115	89.149
B 1924 Jan. 1.0	25.354	48.595	141.935	191.890	114.757	30.614	189.924
1925 Jan. 0.0	25.362	48.593	142.556	192.101	114.652	30.115	229.441
1926 Jan. 0.0	25.371	48.590	143.177	192.312	114.548	29.615	268.957
1927 Jan. 0.0	25.379	48.588	143.798	192.524	114.446	29.116	308.474
B 1928 Jan. 1.0	25.387	48.585	144.421	192.738	114.345	28.615	49.249
1929 Jan. 0.0	25.396	48.583	145.042	192.952	114.246	28.115	88.766
1930 Jan. 0.0	25.404	48.581	145.664	193.166	114.149	27.616	128.282
1931 Jan. 0.0	25.412	48.578	146.285	193.382	114.053	27.116	167.799
B 1932 Jan. 1.0	25.421	48.576	146.908	193.598	113.959	26.615	268.574
1933 Jan. 0.0	25.429	48.573	147.529	193.815	113.867	26.116	308.091
1934 Jan. 0.0	25.438	48.571	148.150	194.033	113.776	25.616	347.607
1935 Jan. 0.0	25.446	48.569	148.772	194.251	113.688	25.117	27.124
B 1936 Jan. 1.0	25.454	48.566	149.394	194.471	113.600	24.616	127.899
1937 Jan. 0.0	25.463	48.564	150.016	194.691	113.515	24.117	167.416
1938 Jan. 0.0	25.471	48.562	150.637	194.911	113.431	23.617	206.932
1939 Jan. 0.0	25.479	48.559	151.258	195.132	113.349	23.118	246.449
B 1940 Jan. 1.0	25.488	48.557	151.881	195.355	113.268	22.617	347.224
1941 Jan. 0.0	25.496	48.554	152.502	195.578	113.189	22.118	26.741
1942 Jan. 0.0	25.504	48.552	153.124	195.801	113.112	21.618	66.258
1943 Jan. 0.0	25.513	48.550	153.745	196.025	113.037	21.119	105.774
B 1944 Jan. 1.0	25.521	48.547	154.368	196.250	112.963	20.618	206.550
1945 Jan. 0.0	25.530	48.545	154.989	196.475	112.891	20.119	246.066
1946 Jan. 0.0	25.538	48.542	155.610	196.700	112.821	19.619	285.583
1947 Jan. 0.0	25.546	48.540	156.231	196.927	112.753	19.120	325.099
B 1948 Jan. 1.0	25.555	48.538	156.854	197.154	112.686	18.619	65.875
1949 Jan. 0.0	25.563	48.535	157.476	197.381	112.621	18.119	105.391
1950 Jan. 0.0	25.571	48.533	158.097	197.609	112.558	17.620	144.908
1951 Jan. 0.0	25.580	48.530	158.718	197.837	112.497	17.120	184.424
B 1952 Jan. 1.0	25.588	48.528	159.341	198.067	112.438	16.619	285.200
1953 Jan. 0.0	25.596	48.526	159.962	198.296	112.380	16.120	324.716
1954 Jan. 0.0	25.605	48.523	160.583	198.526	112.324	15.620	4.233
1955 Jan. 0.0	25.613	48.521	161.204	198.756	112.270	15.120	43.749
B 1956 Jan. 1.0	25.622	48.518	161.827	198.988	112.218	14.619	144.525
1957 Jan. 0.0	25.630	48.516	162.449	199.219	112.167	14.120	184.041
1958 Jan. 0.0	25.638	48.514	163.070	199.450	112.118	13.620	223.558
1959 Jan. 0.0	25.647	48.511	163.691	199.682	112.072	13.120	263.074
B 1960 Jan. 1.0	25.655	48.509	164.314	199.915	112.026	12.619	3.850

Reduction for Hours.

Hour.	u_{Ψ}
	°
1	2.552
2	5.105
3	7.657
4	10.210
5	12.762
6	15.315
7	17.867
8	20.420
9	22.972
10	25.525
11	28.077
12	30.629
13	33.182
14	35.734
15	38.287
16	40.839
17	43.392
18	45.944
19	48.497
20	51.049
21	53.602
22	56.154
23	58.706
24	61.259

Reduction for Minutes.

Minute.	u_{Ψ}
	°
1	0.043
2	0.085
3	0.128
4	0.170
5	0.213
6	0.255
7	0.298
8	0.340
9	0.383
10	0.425
20	0.851
30	1.276
40	1.702
50	2.127
60	2.552

Errata in Greenwich Annual Volumes.

Greenwich Observations 1904.

Page 153, Solutions.	Substitute values on page 321 of this volume, changing + to − and − to +.
Page 154, Solutions.	Change value of Q 180°.
Page 155, Solutions.	Change value of Q 180°.

Greenwich Observations 1905.

Page 175,	Mar. 9,	Tabular Position Angle.	For 296.18 read 297.06
		Tab.—Obs. Position Angle.	For +0.42 read + 1.30
		Tabular Distance.	For 14.51 read 14.40
		Tab.—Obs. Distance.	For +0.33 read + 0.22
Page 177,	Dec. 7,	sin dI Position Angle.	For 0.0 read − 0.6
		$2e$ cos Q Position Angle.	For 0.0 read +16.9
		sin du Distance.	For 0.0 read + 0.4
		sin dN Distance.	For 0.0 read − 0.4
		sin dI Distance.	For 0.0 read −12.8
		$2e$ sin Q Distance.	For 0.0 read + 5.5
		$2e$ cos Q Distance.	For −0.1 read − 0.5
	Feb. 17,	sin dN Position Angle.	For +4.9 read − 6.3
		sin dI Position Angle.	For 0.0 read + 0.5
	Mar. 9,	s sin dp.	For +0.11 read +0.33
		ds.	For +0.33 read +0.22
	Normal Equations.		Substitute values on page 322 of this volume, changing the signs of the right-hand members.
	Solutions.		Substitute values on page 322 of this volume, changing + to − and − to +.
	Column Residual, Position Angle.		Read from top to bottom: +.19, −.12, +.27, +.10, +.06, −.17, −.07, −.01, −.07, +.16, −.14, −.17, +.17, −.24, +.18, −.29, +.03, +.14, +.18, +.05, −.05, +.02, −.09, −.06, +.18, −.01, −.17.
	Column Residual, Distance.		Read from top to bottom: +.09, −.01, +.43, −.20, +.12, +.12, −.02, +.02, −.06, −.09, −.04, +.02, +.38, +.14, −.40, +.10, −.06, +.03, +.10, +.16, −.04, −.27, +.01, −.26, −.08, −.04, +.35.

Greenwich Observations 1906.

Page 180, Normal Equations.	Substitute for right-hand members values on page 322 of this volume with their signs changed.
Solutions.	Substitute values on page 322 of this volume, changing + to − and − to +.
Column Residual, Position Angle.	Read from top to bottom; −.22, +.14, +.07, −.14, +.01, −.03, −.06, −.10, −.02, +.07, .00, −.01, −.05, −.07, +.13, +.16, −.06, +.12, −.11, +.01, +.04, −.02, −.14, +.25.
Column Residual, Distance.	Read from top to bottom: +.34, +.38, +.06, +.04, +.07, +.07, +.01, −.06, −.06, +.50, +.07, +.09, +.01, −.39, −.08, −.10, −.28, +.02, +.02, −.08, +.05, −.28, −.14, −.01.

Errata in Greenwich Annual Volumes—Continued.

GREENWICH OBSERVATIONS 1907.

Page 211, Solutions, Q.	For 69° 37′ read 250° 48′

GREENWICH OBSERVATIONS 1908.

Page 195, Dec. 10, sin dN, Distance.	For − read +.
Feb. 3, sin dN, Distance.	For + read −.
Feb. 6, sin dN, Distance.	For + read − .
Normal equations, sin dN.	For −785 read −906.
sin dI.	For −198 read −258.
$2e$ sin Q.	No change.
$2e$ cos Q.	For + 89 read +218.
$\frac{da}{a}$	For +560 read +534.
Right-hand number.	For +5.60 read +4.09.
Solutions.	Substitute values on page 323 of this volume, changing + to − and − to +.
Column Residual, Position Angle.	Read from top to bottom: +.22, −.16, +.04, −.09, −.14, −.17, −.34, −.03, +.07, −.02, +.20, +.26, +.14.
Column Residual, Distance.	Read from top to bottom: −.04, −.11, +.28, +.31, −.27, +.01, −.04, +.08, .00, −.07, +.03, +.16, −.08.

GREENWICH OBSERVATIONS 1911.

Page C70, sin dI, Position Angle.	Change all signs.
$2e$ sin Q, Position Angle.	Change all sings.
$2e$ sin Q, Distance.	Change all signs.
Feb. 11, sin du Position Angle.	For −16.42 read −16.50.
sin dN Position Angle.	For − 9.19 read + 6.19.
sin dI Position Angle.	For − 3.95 read + 2.87.
$2e$ sin Q Position Angle.	For +16.04 read − 6.24.
$2e$ cos Q Position Angle.	For + 3.48 read +15.27.
sin du Distance.	For − 0.13 read − 2.30.
sin dN Distance.	For − 0.05 read + 5.17.
sin dI Distance.	For + 0.02 read −11.32.
$2e$ sin Q Distance.	For + 1.33 read + 4.34.
$2e$ cos Q Distance.	For − 5.50 read + 4.26.
$\frac{da}{a}$ Distance.	For +11.33 read +11.28.
ds.	For + 0.03 read − 0.02.
Apr. 1, $2e$ sin Q Distance.	For + 5.59 read + 1.95.
Normal Equations.	Substitute values on page 323 of this volume, changing the signs of the right-hand members.
Solutions.	Substitute values on page 323 of this volume, changing + to − and − to +.
Column Residual, Position Angle.	Read from top to bottom: −.04, +.09, −.17, +.02, −.05, +.06, +.45, −.04, .00, −.03, +.06, −.07, +.05, −.05, +.05, +.06, −.10, .00, +.06, −.06, +.03, −.13.
Column Residual, Distance.	Read from top to bottom: −.29, +.04, −.04, +.07, +.22, −.05, −.10, +.03, −.03, −.01, −.03, −.01, +.02, −.06, +.16, −.01, −.13, +.04, +.12, +.02, −.03, +.15.

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